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ABSTRACT

This book helps middle school and high school students address environmental issues in an intelligent and productive manner. The lessons introduce economic reasoning and show students how to apply it to environmental problems. The 18 lessons are divided into four units addressing: the environment and the economy; incentives; use of market forces to improve the environment; and public choice theory and the environmental movement. Lesson titles include: (1) "The Problem of the Homeless Salmon"; (2) "Romancing the Past"; (3) "Own It or Lose It"; (4) "The Environment: Who Loves Ya, Baby?"; (5) "How Clean Is Clean Enough?"; (6) "How Can We Help the Endangered Species?"; (7) "Using Rewards to Protect Endangered Species"; (8) "The Costs and Benefits of Having Children"; (9) "Why Are There So Few Whales and So Many Chickens?"; (10) "Why Do Nonrenewable Resources Keep Increasing?"; (11) "Can Insecticides Help Us Fight Cancer?"; (12) "Why Drive When You Can Ride?"; (13) "Will There Be Enough Food For You?"; (14) "Do We Make Too Much Stuff?"; (15) "Save the Babies"; (16) "Why Would People Cut Down Trees in a Public Park?"; (17) "The Mystery of the Disappearing Christmas Trees"; and (18) "What is Worth Recycling?" (EH)

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Economics America

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Economics and the Environment

EcoDetectives

Mark C. Schug • John S. Morton • Donald R. Wentworth

PERC

Economics America
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A partnership of education, business, and labor

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FOREWORD

In the past few years, environmental problems have been a major topic of concern. Issues such as protecting endangered species, recycling, and resource depletion are featured on television, in newspapers, and in movies. The search for solutions to these problems has profoundly affected government policies. Such problems are also the subject of intense scrutiny and discussion in classrooms.

This series of lessons, *EcoDetectives*, by Mark C. Schug, John S. Morton, and Donald R. Wentworth, helps middle and high school students address environmental issues in an intelligent and productive manner. The lessons introduce economic reasoning and show students how to apply it to environmental problems in engaging, thought-provoking ways. For example, students figure out why, in spite of today's emphasis on recycling, we still find bottles, cans, and papers routinely tossed into landfills. Students also figure out why people sometimes attempt to kill wildlife listed as endangered species.

Armed with a better understanding of human behavior, students begin to devise reasonable solutions to environmental concerns. They figure out what policies might save endangered salmon and what policies might spur park protection.

Teachers need little background in formal economics to use *EcoDetectives*, although teachers who have studied economics will recognize fundamental economic themes that inform the lessons. The lessons can be used in a variety of subject areas, including environmental, social studies, and science classes.

The authors are well-versed in economics and prominent in the field of education. Mark Schug, John Morton, and Donald Wentworth have written several professional books and articles, as well as economics curricula for middle and high schools. All three have extensive classroom experience.

We appreciate the work of PERC (the Political Economy Research Center), which originated this curriculum. PERC is a research center in Bozeman, Montana, that explores market solutions to environmental problems. PERC scholars, including Executive Director Terry Anderson, Richard Stroup, Donald Leal, Peter J. Hill, and others, have been pioneers in applying sound economic reasoning to environmental problems. We also appreciate the contributions of Michael Copeland, who initiated this project at PERC, and Jane Shaw, who oversaw it as PERC's director of Environmental Education, a post now held by Donald Wentworth. We are especially grateful to the Jacquelin Hume Foundation and Fieldstead & Company for the financial support that made possible the development and publication of the curriculum.

The National Council believes that *EcoDetectives* will prove to be an important component of middle and high school environmental education. We are pleased to have a role in helping today's young people become conscientious citizens who can effectively address environmental concerns in the 21st century.

Robert F. Duvall, President and CEO

National Council on Economic Education

INTRODUCTION

EcoDetectives is an 18-lesson curriculum that helps teachers and students learn to apply economic reasoning to important environmental issues. Students apply economic principles as they become ecodetectives. They learn how to solve persistent environmental mysteries. Here are some examples:

- Why are the salmon in the Snake River area declining in number when people want them to increase?
- If the environment is cleaner today than it was 25 years ago, why are people so worried about it?
- Why would some people with good intentions attempt to kill wildlife listed among the endangered species?
- Why do people in poor nations generally have more children than people in rich nations?
- How can the amount of oil (a nonrenewable resource) increase when greater amounts of oil are burned every day?
- How are insecticides, materials associated with causing harm to the environment, important weapons in the fight against cancer?
- Why do people wait in traffic when they can ride on buses and help the environment?
- When Earth's population grows, why don't the people of Earth starve?
- Why would giant fir trees disappear after the government bought the forest land for use as a park?
- How can recycling newspapers result in having fewer trees?
- Why are many bottles, cans, and papers still tossed into landfills?

As these examples suggest, the analysis of environmental mysteries, the goal of this program, challenges teachers and students to think about the environment and environmental policies in new ways. Many diverse curriculum materials are currently available to help students learn about the environment. *EcoDetectives* lessons focus on the current environmental situation and some new policies being offered to improve the protection of the environment. They are supplementary materials to use along with other source materials on the environment.

New Perspectives on Protecting the Environment

Why are these lessons needed? Much has changed in the environmental protection field in this decade. New policies have been invented and tried. Environmental protection continues to be an area where strong agreement on goals exists but serious, often bitter, disputes rage regarding the means to accomplish these goals. For example, no person or business wants to be identified as an enemy of environmental policies, but they will strongly dispute policies that made them bear an unfair share of the costs of protecting the environment. On the other hand, environmentalists do not want to be opposed to improving the economic well-being of citizens, yet they also do not want to let environmental abuse continue because it "costs too much" to protect the environment. It is possible to reach more consensus among citizens on both questions of environmental goals and environmental protection. *EcoDetectives* help students answer that question for themselves.

The lessons in *EcoDetectives* help students investigate policies that help many people reach environmental goals, reduce the cost of environmental protection, and gain greater social cooperation. In most cases, these lessons study market-based incentives because economists tend to recommend policies that make greater use of positive incentives rather than negative sanctions as a means to promote environmental stewardship.

Why should students learn about these ideas? For many years, some people argued that market forces threaten the environment while proponents of economic growth argued that environmental concerns interfere needlessly with efforts to improve standards of living. Recently, environmental economists have helped both groups realize that economic growth, market forces, and environmental protection are not incompatible. In fact, market forces can be used to improve environmental quality. Greater consensus among envi-

ronmental groups and economic growth advocates came about because of three factors.

First, government actions have been used extensively to protect environmental quality in this country for more than 25 years. After World War II, economic pressures and new technologies began the cleanup of our air and water, and, starting around 1970, environmental regulations played a big part. Rivers no longer burn. Exhaust from smoke stacks no longer obscures our vision and damages our lungs. Much remains to be done to protect the environment, but many of the issues have changed. Environmental experts fear that regulatory policies could be less effective when dealing with environmental concerns such as endangered species, depletion of fish populations, private use of public lands, population growth, and biodiversity.

Second, economic analysis has helped identify the causes of environmental damage and offered new policy solutions that foster voluntary, private efforts to improve environmental quality. The "tragedy of the commons" is a common theme in environmental economics literature. Garrett Hardin in 1968 wrote a seminal article on it. Joan Robinson, a British economist, followed Hardin's analysis when she asked, "Why is there litter in the public park and no litter in my back yard?" Recognition of the problems associated with common ownership reveals potential solutions. For example, some environmental policies now provide for the creation of quasi-property rights that reward acts of environmental protection. License programs now exist to preserve the fisheries of New Zealand, to reduce the air pollution in large cities, and to provide incentives that reward land owners to protect endangered species and preserve wetlands. A number of lessons in *EcoDetectives* help students identify the problems of common ownership and investigate policies that might produce better environmental protection.

Third, after 25 years of legislation it is clear that some government policies have worked well and others have not worked as well as expected. In *EcoDetectives*, students investigate different policy examples in an effort to discover remedies to improve existing policies. Students learn that it makes little difference whether private or public ownership exists if the incentives involved reward destructive environmental practices. New policies can improve the situation if incentives exist to reward people for protecting environmental quality. Several lessons help students identify problems where inappropriate incentives exist either in the private or public sector that work against environmental protection. These lessons also help students formulate new policies that change the incentives to reward environmental protection.

How does learning take place in *EcoDetectives?* The lessons use active learning strategies that begin by focusing on student behavior and the choices students make when placed in a classroom situation that simulates an environmental problem. Most of these lessons are "hands-on" experiences. Students compare their behavior to the behavior described in environmental disputes. They are asked to use a few principles of economics to guide their thinking and to engage in a powerful, critical-thinking process called EcoDetection.

The Principles of EcoDetection

EcoDetection introduces students to a perspective that encourages them to acknowledge how powerful different incentives are and how they influence the choices everyone makes. The process encourages young people to use reasoning skills to understand the world and to imagine ways to improve it. This task involves use of the following principles of EcoDetection.

1. People's *choices* influence the environment.
2. People's choices have *unintended results*.
3. People's choices are influenced by *rewards*.
4. People are more likely to take better care of things they *own and value*.

Instructional Approaches

EcoDetectives melds several instructional approaches, including direct instruction, inquiry learning, and cooperative learning. The lessons involve students in simulations, demonstrations, discussion, dramatics, reading, and writing. The authors, striving to anticipate common misunderstandings about the economy and about the environment, have taken the learner into account.

Format

EcoDetectives includes 18 independent lessons.

Teachers may use the entire set of lessons or select those most relevant to their needs. The authors recommend that all teachers use Lesson 1 to introduce systematically the principles of ecodetection. Each lesson begins with an introduction that presents background information for the teacher, an ecomystery, and an explanation of the mystery, using the principles of ecodetection. Each lesson also includes a concept list, instructional objectives, and a list of instructional materials including visuals for transparencies and student activities. The teaching procedures begin with a statement of purpose and include discussion questions along with suggested answers. Each lesson ends with a closure activity that reviews learning, provides a summary, or invites additional applications. Finally, each lesson offers suggestions for assessment, including multiple-choice questions, essay questions, and suggestions for journal writing.

LESSON ONE
THE PROBLEM OF THE HOMELESS SALMON

BACKGROUND

Chinook salmon populations in the Columbia and Snake River areas of the United States have been declining, even though most people want them to increase. The wild fish are valued by commercial fishermen, sports fishermen, biologists, and other citizens. Salmon are part of the environment that makes the Pacific Northwest unique. Efforts by Washington, Oregon, and the U.S. government to produce more salmon with fish hatcheries have not worked well. The salmon population is still declining, although more slowly. In addition, hatchery fish are different from the native wild salmon that spawn in riverbeds and live the rest of their lives in the ocean. These wild salmon are the most endangered.

ECOMYSTERY

The wild salmon is the most popular fish in the Pacific Northwest. Everyone wants to increase the wild salmon population. But the estimated salmon population continues to fall. Why?

ECONOMIC REASONING

Salmon are owned by nobody, or everybody, and they suffer from a problem of common ownership. If salmon are harvested, people can benefit; but no one in the fishing business will benefit from holding back on harvesting in order to help the fish reproduce. If one person holds back, someone else may harvest the fish. Private ownership of fish schools could provide the incentive to maintain the fish population. The rivers where salmon spawn are also owned in common, so nobody can exercise ownership rights to foster wild salmon reproduction. Private ownership of water rights and spawning beds may create the incentives necessary to maintain the salmon population.

ECONOMIC CONCEPTS

Choices
Incentives
Costs
Benefits

OBJECTIVES

1. Students identify four principles of ecodetection.

2. Students use the principles of ecodetection as a guide in reasoning about environmental mysteries.

TIME

One class period

MATERIALS REQUIRED

- Visuals 1, 2, 3, and 4
- Activities 1, 2, and 3

PROCEDURE

A. Welcome students to the world of environmental mysteries. Introduce the idea that environmental problems often puzzle people. For example, everyone wants clean air, yet most people help pollute the air when they drive their cars or ride on a bus. Most people like wild animals and fish, yet our uses of land and water sometimes cause the population of wild animals and fish to decline. Why do these contradictions between desire and action exist? The mysteries in this curriculum invite the students to learn about these contradictions and to understand why they exist. Students also work on deciding how to correct environmental problems. Lesson One provides the first illustration of how the ecodetection process works.

B. To begin the environmental investigations, students follow the story of the Chinook Salmon. Display Visual 1 and invite the students to speculate on why salmon populations are decreasing. Display Visual 2 and ask what pattern is indicated by these numbers. (The population has been declining; each year there have been fewer salmon.)

C. Distribute Activity 1, which describes a Chinook Salmon, its habitat, and its life cycle. Ask:

1. Where do the Chinook Salmon live? (North Pacific Ocean and the rivers in streams of Alaska, British Columbia,

Washington, Oregon, and Northern California.)

2. Where do the small-fry fish travel?
(They leave stream beds and travel through streams and rivers to the ocean.)

3. Why do the Chinook leave the ocean?
(After growing, they return to the place where they were born—to leave eggs.)

4. What dangers do the Chinook face in returning to the rivers and streams?
(Death caused by people, bears, other fish, nets, dams, and low water.)

D. Display Visual 3, showing the rivers of the Pacific Northwest. Trace the journey of the Chinook Salmon. The Chinook that make their way to the ocean live there for several years, constantly moving. Then instinct tells them to return to their birthplace and spawn, leaving behind new eggs to produce new salmon. After spawning, the Chinook die, and their remains are eaten by eagles, crows, and other scavengers.

E. Explain that salmon is a very popular fish, served in the best restaurants in the world. Many people make their living catching the fish in the high seas or at the mouths of rivers when the fish return from the ocean to spawn. Sports fishermen pay very high prices to hire guides and purchase equipment in order to fish for salmon every fall in the Pacific Northwest.

F. Explain that the student's task is to propose a solution to the Northwest Power Planning Council to correct the problem of the declining salmon population. The Northwest Power Planning Council was established by the United States Congress to develop a program to protect the Columbia River Basin's fish and wildlife. Ask: How can conditions in the rivers and oceans be changed to allow the number of salmon to increase? Encourage a variety of responses.

G. Explain that one way to solve this problem is to apply a set of principles as a starting point for thinking logically about the evidence.

H. Display Visual 4, **The Principles of EcoDetection**. Explain that this visual introduces the principles students use to solve eco-mysteries. Stress the first assumption of ecodetection: people's choices influence the environment. For example, environmental detectives ask: Why do people make the choices they make? What benefits do they expect? What costs do they encounter?

I. Show how the principles of ecodetection work by asking students to use them in thinking about possible explanations of the salmon mystery. Ask:

1. Do fishermen choose to catch so many salmon that none will exist for the next year? (No.)

2. Can fishermen continue catching fish if they catch so many that none will exist after one year of fishing? (No.)

J. Distribute Activity 2, and divide the class into small groups. Explain that this activity shows how the principles of ecodetection can be used to solve an environmental mystery. Allow students time to read and discuss Activity 2, using the discussion questions as a guide. Discuss the group responses:

1. What human choices affect the environmental quality of the salmon's spawning areas?
(People choose to use electricity, buy paper, build homes, eat food, and so on.)

2. What unintended consequences have resulted from consumers' choices to obtain food and shelter?
(The choices encouraged producers to ignore the salmon habitat and to reduce salmon populations.)

3. What difference does it make that the salmon are wild and no one owns the right to raise and harvest them, as people do with cattle and chickens?
(No one is rewarded for helping the salmon reproduce by protecting their breeding areas. With cattle and chickens, ranchers

who raise and care for the animals also benefit by selling them to the consumer. The prospect of this benefit creates an incentive to raise and care for the animals.)

4. What might be done to increase the salmon population?
(If people owned the rights to water, schools of salmon, and their spawning areas, then fishermen and producers of electricity and lumber could negotiate deals which would allow them to protect the salmon and produce their goods and services also.)

CLOSURE

Ask students to review **The Principles of EcoDetection**. Stress that environmental problems are the result of human choices; therefore, they can be corrected by providing incentives to encourage people to make environmentally friendly choices.

Distribute the EcoDetection Cards in Activity 3, giving one card to each student. Ask students to keep their cards nearby—in wallets or taped in their notebooks—so they can be used whenever the students encounter instances of mysterious behavior in their subsequent work in studying the environment.

ASSESSMENT

Multiple Choice

1. Which of the following statements is consistent with **The Principles of EcoDetection**?
   a. The salmon population is declining because no one cares about the salmon.
   b. The salmon population is declining because people use salmon for food.
   *c. There are few incentives for people to preserve salmon habitat.
   d. If farmers didn't irrigate their crops, the salmon population would increase.

2. Which of the following groups will pay higher costs if the salmon population is preserved and increased?
   a. Logging companies operating near salmon-spawning schools.
   b. Electrical companies operating dams on rivers where salmon travel to spawn.
   c. Consumers.
   *d. All of the groups listed above will pay higher costs.

Essay

Explain how incentives influence human behavior toward salmon and contribute to the decline in salmon populations.
(People are rewarded for harvesting the salmon population. They are not rewarded for helping new salmon hatch and grow to mature adults. Therefore, people spend more time and resources harvesting salmon than they do helping salmon populations grow.)

Journal

Many animals exist in students' neighborhoods. They can note which are increasing in number and which are decreasing in number. For example, is the population of rabbits, cats, deer, dogs, or goldfish changing? Science teachers can help in identifying these population changes. Use **The Principles of EcoDetection** to explain why these changes are taking place.

VISUAL 1

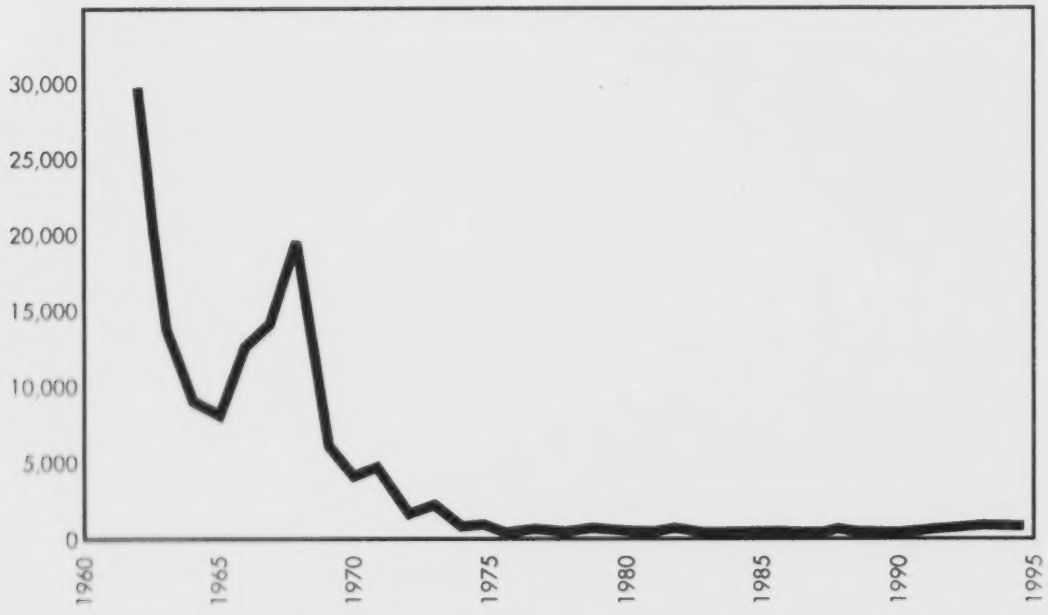
ECOMYSTERY: WHY CAN'T A SALMON RETURN HOME?

Why are the salmon in the Snake River area declining in number when people want them to increase?

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

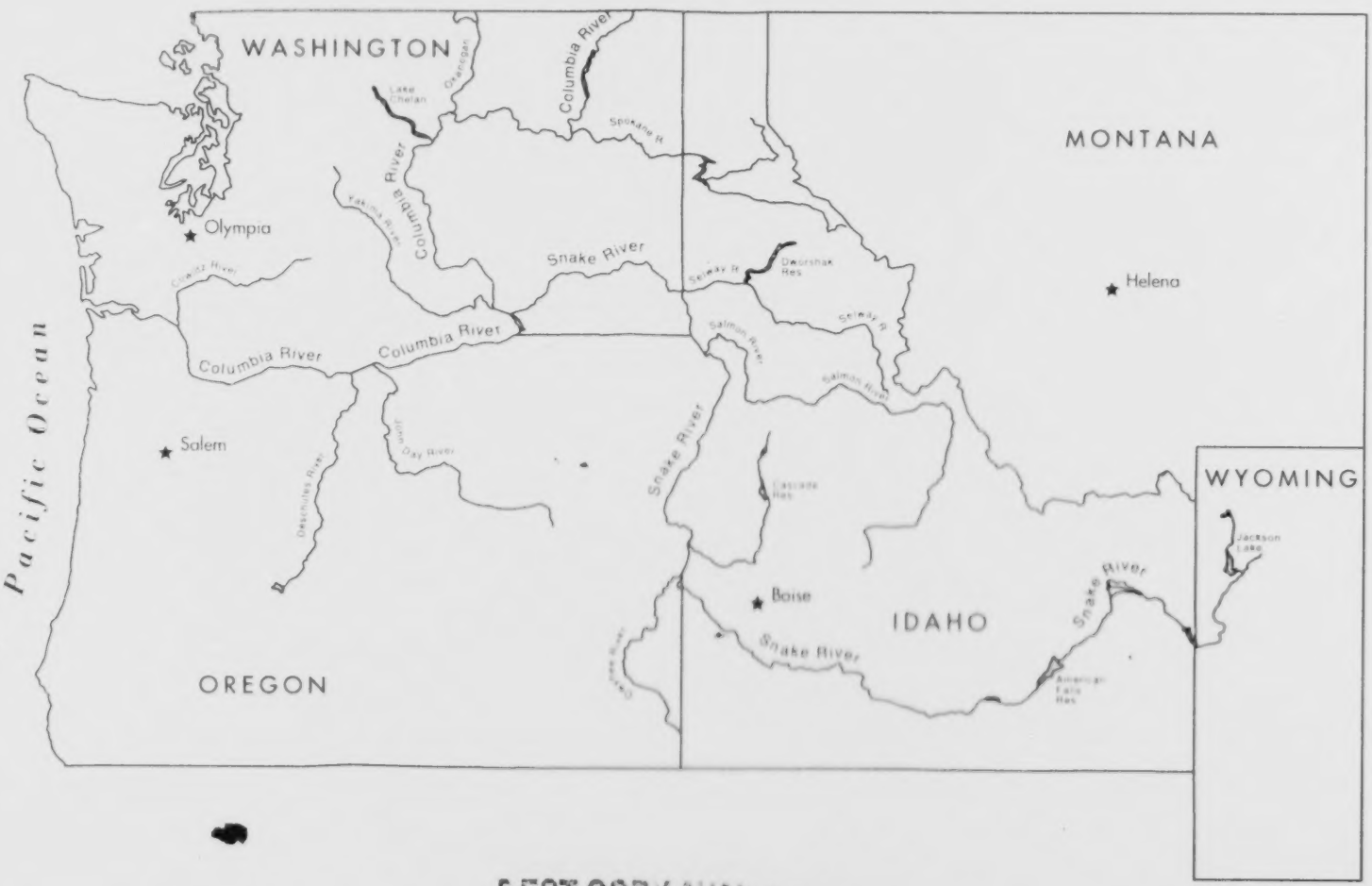
VISUAL 2
SALMON POPULATION

Northwest Power Council Estimates of Salmon Runs in the Snake River area, spring and fall, 1960 to 1994.



Source: *Columbia River Basin: Fish and Wildlife Program.* Northwest Power Planning Council. 1994.

VISUAL 3
MAP OF COLUMBIA AND SNAKE RIVERS



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VISUAL 4

THE PRINCIPLES OF ECODETECTION

1. People's *choices* influence the environment.

2. People's choices have *unintended results*.

3. People's choices are influenced by *rewards*.

4. People are more likely to take better care of things they *own and value*.

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ACTIVITY 1
THE LIFE CYCLE OF THE SALMON

Name_____

The Chinook Salmon lives in the North Pacific Ocean and the rivers and streams in Alaska, British Columbia, Washington, Oregon, and Northern California. It has lived in these waters for one million years.

The fish begin life as eggs left by their mother in the gravel of stream beds. The mother dies shortly after laying the eggs. When the eggs hatch, the small-fry fish must find their way to the ocean, traveling through the rivers and streams of the Pacific Northwest. They live in the ocean for several years, growing to large sizes.

Mature Chinook Salmon may weigh anywhere from 10 to 100 pounds. At some point in their adult life they attempt to return home—to the exact place where they were born—where they will leave eggs to produce the next generation. After spawning, the Chinook Salmon die.

Many animals, fish, and people like to eat salmon. For the species to continue, enough salmon must avoid bears, predator fish, nets, dams and low-water levels in rivers and streams to make it back to their places of birth to plant the new eggs.

Questions for Discussion

1. Where do the Chinook Salmon live?
2. Where do the small-fry fish travel?
3. Why do the Chinook leave the ocean?
4. What dangers do the salmon face in returning to the rivers and streams?

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ACTIVITY 2
WHY CAN'T A SALMON RETURN HOME?

Name _____

Why are the salmon in the Snake River area declining in number when people want them to increase? The following analysis uses **The Principles of EcoDetection** to explain this mystery and suggest a solution to the problem.

PRINCIPLE 1
PEOPLE'S CHOICES INFLUENCE THE ENVIRONMENT.

The salmon population in the Snake and Columbia River areas has been declining sharply. Salmon have used these rivers for centuries. Native Americans caught the fish and used them as their basic diet. They caught relatively few fish, however, and their fishing did not reduce the salmon population. Now, environmental changes have affected the salmon's spawning grounds, and a larger human population and improved fishing equipment have increased the number of salmon caught by fishermen.

The salmon are declining in number in the Snake River area and in other parts of the Pacific Northwest. Until recently, this fish was very abundant. In the 1800s salmon migrated up the streams each fall in such numbers that people could almost walk across the backs of the fish to cross the stream. Now so few salmon remain that recently people were not allowed to fish for them at all during the fall migration season. How did people's choices influence this change in the salmon population?

To answer this question, it is important to remember two things. First, the salmon need to return "home" (to their spawning beds) in order to reproduce. They are born in streams near large rivers and hatch from eggs left there by their mothers. After hatching, the small fish migrate to the ocean, avoiding predator fish and animals if they can, where they live for a number of years, growing strong and large. Then instinct tells them to return to their birthplace to die; but just before their death they leave more eggs to produce future generations. No one knows how the salmon find their way from the oceans to the exact place where they hatched. It is a miracle of nature. But if the salmon fail to reach that location, they cannot leave their eggs and help the species reproduce. When people block off rivers with dams, or destroy spawning areas in streams, they prevent the salmon from returning home.

Salmon used these rivers and streams before human beings lived in the Pacific Northwest. The original Americans lived off these fish, but their catch was so small it did not diminish the population. Now environmental changes and a larger human population have made a serious impact on the salmon's spawning grounds.

PRINCIPLE 2
PEOPLE'S ENVIRONMENTAL CHOICES HAVE UNINTENDED RESULTS.

Must the salmon remain homeless, blocked off from their birthplace? Not necessarily. There is plenty of space for them, just as we have space for cattle, buffalo, and birds. Why are we having a problem with the salmon?

No one set out to harm the salmon. Instead, people chose to improve their own environmental conditions. People chose to use electricity to heat and cool their homes; this choice led them to build huge dams on the Columbia River. These dams block the salmon's migration routes to their spawning grounds.

People also chose to eat salmon, and this choice encouraged commercial fishermen to expand their catch of salmon in the ocean and at the river mouths. The fisherman's success meant fewer salmon could return to their spawning grounds. Bigger boats, more nets, and better radar helped fishermen increase their catch.

People chose to cut down trees in order to build homes and manufacture paper products. The log-

ACTIVITY 2 (continued)

ging activities that provided these products caused soil erosion, flushing mud down hillsides to cover the sand and rock beds in the streams where salmon leave their eggs.

All of these choices were made to improve the lives of humans. None was intended to ruin salmon's habitat, but that was the unintended effect.

PRINCIPLE 3
PEOPLE'S CHOICES ARE INFLUENCED BY REWARDS.
People who use the salmon's habitat or catch the salmon are rewarded for their behavior. Fishermen get paid for the salmon they catch. Loggers are paid to cut trees, not to protect streams from mud. Electric companies satisfy customers by providing electricity from dams, not by providing water for fish to live in. But who is rewarded for helping salmon? Anyone who wants to help the salmon must do it without receiving monetary rewards. Some people do help anyway, but most people cannot spend their time cleaning streams or helping fish pass by the large dams. Therefore, today, the wild Chinook Salmon are not cared for. They are only captured or neglected.

PRINCIPLE 4
PEOPLE ARE MORE LIKELY TO TAKE BETTER CARE OF THINGS THEY OWN AND VALUE.
Compare wild salmon with cows or chickens. The salmon are nobody's property. If they were someone's property, the owners would not have ruined the salmon's water and habitat. Dairy farmers, after all, do not destroy barns or pastures. But since no one owns the salmon or their habitat, the fish can be taken and the habitat can be changed with no obvious cost to the person making the change. No one who has used the salmon or the salmon habitat has had to pay anybody for that use. Lumber companies were not required to restore the stream habitat. Consumers were not required to pay extra so that money would be available for restoring the salmon population. Electricity customers were not required to compensate anyone for blocking the rivers with dams. Farmers irrigating their land were not required to compensate anyone for reducing the amount of water available for salmon migration.

Would the decline of the salmon population have occurred if someone had owned the salmon and the salmon habitat? Probably not. If people had been allowed to own and benefit from the wild salmon, fishing and habitat choices would have been made much differently. Not everyone could have caught a salmon. Only people who owned the salmon or paid the owner could have harvested salmon.

But how could we create ownership rights to salmon? There are several possibilities. One idea would be to sell water rights. How would this work? Remember that there is much competition for different uses of the water in the Columbia and Snake Rivers. The United States government could pass legislation making the use of water a privilege that people could purchase. The government could then sell water rights along the Snake and Columbia Rivers to people who wanted to protect the salmon and who would eventually be able to benefit from a regulated harvest of the salmon. Electric companies would be required to pay the owners of water rights for permission to use the water. This requirement would encourage the electric companies to be careful in their use of water resources. The electric companies would seek alternative ways of producing electricity if the costs of water became too high.

Another idea would be to sell the salmon's spawning beds. Land developers and logging companies often change the river in such a way that the salmon's spawning beds are destroyed. When this happens, salmon obviously are not able to return to their home to spawn. If the spawning beds were sold to people who wished to protect and eventually harvest salmon, developers and loggers would either have to pay for permission to change the environment or seek other alternatives.

Still another idea might be to have the United States government sell schools of salmon to private owners. This alternative would involve iden-

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ACTIVITY 2 (continued)

tifying schools of wild salmon and using large gates installed at the mouths of the rivers to block the passage of the salmon into the ocean. The private owners of salmon would become "salmon farmers." They would manage their salmon populations, harvesting a few every year but making sure that salmon would thrive into the future. After all, the salmon farmers' livelihoods would depend on a sustained salmon population.

Will the salmon survive? We don't know. Some efforts are being made to help the salmon through governmental programs—limiting the fishing season, for example, or changing river water levels, or regulating the impact of logging on streams—but it is hard to solve the problem of the wild salmon in these ways. The salmon can be taken by anyone in the oceans 200 miles beyond our shorelines. No one cares for the salmon in remote ocean environments. And within the United States there are many incentives to use rivers and streams for purposes other than salmon habitat. Unless some type of ownership plan is developed for the salmon, it is likely that the population will continue to decline.

Questions for Discussion

1. What human choices affect the environmental quality of the salmon's spawning areas?

2. What unintended consequences have resulted from the choices of consumers to obtain food and shelter?

3. What difference does it make that the salmon are wild and no one owns the right to raise and harvest them, as people do with cattle and chickens?

4. What might be done to increase the salmon population?

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ACTIVITY 3
ECODETECTION CARDS

The Principles of EcoDetection

1. People's choices influence the environment.
2. People's environmental choices have unintended results.
3. People's choices are influenced by rewards.
4. People are more likely to take better care of things they own and value.

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LESSON TWO
ROMANCING THE PAST

BACKGROUND

Today the standard of living for most Americans is higher than ever before. And research from many sources indicates that the environment is cleaner today than it was 25 years ago. The air and water are cleaner. There are more trees, not fewer. There is more food. People today live longer than at any time in our past. Yet public opinion polls show that Americans worry increasingly about the destruction of forests and wetlands, the extinction of endangered species, a depleted ozone layer, global warming, melting glaciers, and dirty air and water.

ECOMYSTERY

If the environment is cleaner today than it was 25 years ago, why are people so worried about it?

ECONOMIC REASONING

Scarcity exists because people's wants are never satisfied. What people want depends usually on how wealthy they are. Poor people in poor nations face starvation and disease. For them, basic issues include the provision of clean drinking water, for prevention of disease, and effective land use, for food production.

People in wealthier nations want clean water and enough food to eat, too, but they can satisfy such wants more easily than poorer people can. They do not have to spend all or most of their time and money on basic matters of survival. They can afford to take an interest in environmental *quality*: in clean water for swimming and fishing, not merely for drinking; in forests to camp in, not merely forests to clear away so that crops can be planted. It is wealth, created by economic growth, that enables people to address these problems of environmental quality. As the U.S. economy has grown, Americans have sought increasingly to improve environmental quality.

ECONOMIC CONCEPTS

Economic growth
Scarcity

OBJECTIVES

1. Students compare and contrast the quality of life in the United States today and in the past.

2. Students analyze why rich nations have a cleaner environment than poor nations.

3. Students discuss whether their generation will have a lower or higher standard of living than their parents' generation.

4. Students analyze why greater wealth leads to a greater demand for environmental quality.

TIME

Two class periods

MATERIALS

- Visuals 5 and 6
- Activities 4 and 5

PROCEDURE

A. Tell students that the class is going to discuss whether people in the United States today live better or worse than they did when they were born and when their parents were born.

B. Distribute Activity 4. Tell students that their homework for this evening is to interview a family member of a different generation and to write down responses to the questions on the poll sheet.

C. On the following day, compile the results of the poll and discuss them. At this time, do not discuss the reasons for the answers. However, do make a list of household items we use today that did not exist when the students' older family members were born.

D. Give each student a copy of Activity 5, **The Good Old Days?** Either give students the rest of the period to read the chapter from *Trashing the Planet* or assign it as homework.

E. Discuss Activity 5. Ask students:

1. How did the quality of the air 50 years ago compare to the quality of the air today? (Coal, wood furnaces, and pollution from factories made air worse 50 years ago.)

2. What are some common household appliances today that did not exist 50 years ago or in some cases 20 years ago? (Televisions, VCRs, computers, calculators, CD players, word processors, food processors, microwaves, and so on.)

3. How does medical care today compare to the medical care of 50 years ago? (Fifty years ago food poisoning was common; there were more infectious diseases; tuberculosis and polio were common; antibiotics did not exist; and the state of medical technology was much lower.)

4. Has the rate of improving the way people live been increasing or decreasing during the past several years? (Increasing. The rate of improvement in the way humans live has improved more in the past 50 years than in all of human history.)

5. What are some ways that life today is worse than it was 50 years ago? (There is more crime. AIDS is a problem. People often have difficulty coping with the expansion of knowledge and changes in technology.)

6. Would you rather live today or 50 years ago? (While answers may vary, it would seem difficult for students to argue that life was preferable 50 years ago.)

7. Do increases in knowledge and technology appear to make life better or worse? (Based on the improvements cited in the reading, knowledge and technology make life better.)

F. Now compare these answers to the responses to the poll. It is likely that family members believe that life in the past was worse than today, but answers may vary.

G. Ask students: If the environment is cleaner today, why are people so concerned about it? (People are wealthier, and one of the goods they demand more of is a cleaner environment. Also point out that wealthier countries have a cleaner environment than poorer countries.)

H. Explain that economic growth is the increase in the amount of production from one year to another. If all of the nation's final goods and services were in a cupboard, the amount of stuff in the cupboard would be greater at the end of the year than at the beginning—if economic growth occurred. Economic growth makes it easier for us to afford more of the things we would like to have. If there is economic growth, people can afford to improve the environment. This is why wealthy nations have a cleaner environment than poor nations.

I. Display and discuss Visual 5. Point out that a market economy promotes economic growth, and economic growth helps the environment. Discuss why Dr. McCloskey believes only war and socialism will cause America to decline. (A market economy creates incentives for economic growth.)

CLOSURE

Display Visual 6 and discuss the mystery. Display **The Principles of EcoDetection** and focus the students' attention on principles 1 and 3 to help them solve the mystery.
(*People's choices influence the environment.* As a nation's economy grows, citizens are more willing to use more of their resources to improve the environment. *People's choices are influenced by rewards.* In the United States and in other developed nations, people are rewarded for being productive. People receive better incomes, for example, when they are successful in business. Rewards for being productive create wealth, and the economy grows. Some resources can be used to improve the environment. When people are not rewarded for being productive, economies shrink. Some nations have experimented with economies that failed to reward productive activities. These nations have experienced little economic growth and have had few resources to devote to environmental improvement. The former Soviet Union in an example of this.)

ASSESSMENT

Multiple Choice

1. What is the most important factor in improving the standard of living?
   a. A stronger national defense.
   b. More government programs.
   *c. More economic growth.
   d. More rules and regulations to protect the environment.

2. Which type of country has the cleanest environment?
   a. Poor nations, because they have few factories.
   *b. Rich nations, because they can afford to pay for environmental programs.
   c. Socialist nations, because their greater government control forces people to clean up the environment.
   d. Nations with warmer climates, because they need to burn less fuel.

Essay

Do you believe you will have a better or worse life than your older family members?
(Answers will vary, but there is every reason to believe that the United States will continue to have economic growth and that students' lives will be better.)

Journal

Interview a grandparent or someone of that generation; find out what life was like when these people were your age. Discuss technology, use of leisure time, family size, disease, working conditions, and schooling.

VISUAL 5
THE SKY IS NOT FALLING

"America is not declining. In the modern world, no income per head actually declines in absolute terms, unless through war and socialism.

"The world is converging. No one is going to be Top Nation in that happy era when the whole world has an American suburban standard of living and more. America will go on growing, as it has slowly for two centuries, and the latecomers will join the parade. That's the good news, enriching us all. Give thanks: The sky is not falling."

Donald N. McCloskey
Phi Beta Kappa Key Reporter
Winter, 1994-1995

From *Economics and the Environment: EcoDetectives.* © National Council on Economic Education, New York, NY

VISUAL 6

ECOMYSTERY: ENVIRONMENTAL QUALITY

If the environment is cleaner today than it was 25 years ago, why are people so worried about it?

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ACTIVITY 4
FAMILY POLL

Name _____

Ask your family the following questions and carefully record their answers.

1. Do you believe the environment is cleaner or dirtier today than it was when I was born?

   _____ Cleaner

   _____ Dirtier

2. Do you think people live better or worse today than when I was born?

   _____ Better

   _____ Worse

3. What are some household items that we have today that did not exist when you were born? (List five items.)

   _____

   _____

   _____

   _____

   _____

4. Do you believe that when I grow up I will be better or worse off than you?

   _____ Better off

   _____ Worse off

   Why do you think so?

   _____

   _____

   _____

   _____

   _____

   _____

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ACTIVITY 5
THE GOOD OLD DAYS?*

Name _____

Technology, defined as the application of scientific knowledge to the solution of practical problems, has provided the opportunity for improvement in the lives of all those people fortunate enough to live in the advanced, industrialized, high-tech world that we identify as Western civilization. No matter the recent blossoming of awareness of nature; the natural world is a tough place in which to live. I know. I was born into a world far more "natural" than today's. Let me recall how it was 75 years ago.

The world in which I spent my early years was a very smelly place. The prevailing odors were of horse manure, human sweat, and unwashed bodies. A daily shower was unknown; at most there was the Saturday night bath.

Indoors the air was generally musty and permeated by the sweetly acrid stench of kerosene lamps and coal fires. It was the era of the horse and buggy, the outhouse, and dirt. Depending upon the weather, it was either dusty or muddy. Only a few urban streets were paved—with cobblestones or brick. Mud puddles and corrugated ruts or "corduroy roads" were the potholes of my youth.

Automobiles had been invented, of course, but they were few in number, handcrafted, and expensive enough so that only the rich could afford them. I was nearly 10 years old when the Model T began to put America on wheels. Indeed, Mr. Henry Ford made a greater contribution to public health than most practitioners of science by introducing an affordable auto—which led to the eventual elimination of horse manure from public streets. I was still quite young when airplanes proved their worth in World War I. On rare occasions, especially during the summer, one could be heard overhead, and everyone rushed outside to marvel that something so big could actually fly! No one dreamed that air travel would one day be taken for granted.

Long distance travel was by steam-driven train or boat. For shorter distances, one walked. In town were trolleys, first horse-drawn and then electric-driven. Most people did not venture far from home.

Electrification of cities and homes was much talked about. Gas lights were slowly being replaced with electric lights. But the "gas works" that burned coal and produced manufactured gas persisted for decades and fouled the city atmosphere. Electricity in the home usually meant a single 15 or 25 watt light bulb hanging from a wire in the center of a room. No matter where you stood or what you did, you were nearly always in your own shadow. I remember the first free-standing table lamp in our home. It was 1922, and I was eight years old.

It was a long time before electricity extended to household appliances. There were no electric refrigerators or freezers. Food was kept in a "cooler" or an icebox. The latter was a great improvement, especially for meat and dairy products, but it worked because the ice melted. This meant the accumulation of water in a "drip pan" under the icebox; it was a small daughter's chore to empty that pan every day without spilling it.

There were no thermostats in the home of my childhood. Furnaces were replacing fireplaces as the main heating unit. The furnace burned wood or coal. One learned very young how to bank the fire for the night, how to shake down the ashes, and, in the case of coal, how to remove the klinkers. Rotten duty!

The world I was born into had no electric irons or toasters and no vacuum cleaners. We used brooms and carpet beaters and muscle. There were no electric washing machines or dryers, only tubs that could be heated on the kitchen stove. A scrubbing board, hand wringer, and clothes line completed the equipment for washing clothes.

* This reading is from Dixie Lee Ray, *Trashing the Planet*, Harper, 1992. Used with permission.

ACTIVITY 5 (continued)*

Such things as an automatic dishwasher, food processor, or microwave were unknown.

There was no radio, no television, no VCR. Music, other than that from instruments played by family members, came from a hand-cranked record-playing machine, called a "Victrola." There was no air conditioning. Telephones existed but no satellite communications, no word processors, no calculators, no computers, no electronics. Business machines consisted of a hand-cranked "adding machine" and a manual typewriter. There were no plastics, no ceramics, no prestressed concrete structures, and no synthetic fibers.

The very first man-made thread was rayon, introduced about 1927. Cloth, for clothing and other purposes, was made only from natural fibers, cotton, wool, silk, and linen. Imagine trying to clothe people today with only those fibers available. As it was, most people had few clothes; that is, few changes. It was common to own only two sets, one for "every day" and one for Sunday or "dress up." I could go on and on. But permit me, instead, to turn to two fields wherein the differences between my youth and today—and the improvement and progress—have been truly dramatic: food production and medicine.

When I was young, fresh food could be eaten only when in season. Some fruits and vegetables could be preserved by canning, but the processes for safe home canning were poorly understood and unreliable. Food poisoning was common. Every year people were stricken with botulism and salmonella or various digestive upsets caused by eating decayed or tainted food. During the winter, therefore, only potatoes, carrots, cabbage, winter squash, onions, and dried beans were generally available. Some people ate rutabagas, turnips, and parsnips, but, in our family, these were considered "horse food." Only with the introduction of widespread refrigeration of rail cars and boats, warehouses, and grocery food containers could fresh food be brought to the customer throughout the year.

Refrigeration vastly expanded the market for all foods—meat, dairy products, fruits and vegetables—and that required that more food be grown. The remarkable productivity of American farmers depends in no small degree on the proper use of artificial fertilizers, herbicides, and pesticides. Improved production technology and good management have made it possible to reduce the amount of land devoted to growing food by more than 450 million acres.

As Dr. Norman Borlaug has said, "Without the availability and proper use of chemical fertilizers, herbicides, insecticides, and fungicides, the worldwide demands for food cannot be met."

Certainly they have improved the nutrition and diet of people in America, and astonishing as this change has been, it is equalled or excelled by the improvements in medicine and health.

Infectious childhood diseases were a fact of life during my youth. Epidemics were common and most families were familiar firsthand with whooping cough, measles, mumps, pneumonia, diphtheria, scarlet fever, chicken pox, and more. Body lice causing a severe itch, called the "seven-year itch" (which has taken on a very different connotation in recent decades), infested schools and their inhabitants. In my home town, the last smallpox epidemic was recorded in 1923-24. Poliomyelitis, or polio, for which there was no preventative and no treatment, was called infantile paralysis. It left many children crippled or confined for life in an "iron lung." I was in junior high school when polio last hit many of my classmates. Then there was an ailment known as "brain fever," probably meningococcus infection, for which there were no antibiotics. Many children suffered something we called "growing pains." It wasn't a TV program; it was childhood rheumatism, and it left its victims with hearts that were weakened for life.

If one survived childhood diseases, and many did not, there was always "galloping consumption" or tuberculosis waiting for young adults. So common was "TB" that most communities had a special hospital called a sanatorium for its victims.

* This reading is from Dixie Lee Ray, *Trashing the Planet*, Harper, 1992. Used with permission

ACTIVITY 5 (continued)*

I grew up in a "goiter belt" and remember when adults, especially women, were often afflicted and grew enormous swellings of the throat. This unsightly malady was cured by a simple expedient, one of the first introductions of a chemical into the diet—in this case, the element iodine—by adding it to common table salt.

The control, and in many instances the virtual elimination, of childhood infectious diseases has come about through the use of medical technology. It is a good thing. Now, of course, we can direct our worry and hand-wringing against cancer.

The improved health that results from a better understanding of physiology, biochemistry, nutrition, and pharmaceuticals has led to a longer and healthier life. The belief that the "good old days" were simple, benign, and kind is *wrong!* The reality is those days were dirty, disease-ridden, and smelly.

When this century began, human life was almost totally dependent upon the whims of uncaring nature and the availability of already existing natural resources. This is no longer true. In the last 50 years, we have seen more of a gain in human independence and more changes in the way humans live and what humans can do than occurred in all human history up to the twentieth century. We have been privileged to live through the most extraordinary five decades of expanding knowledge and its use for bettering life that the world has ever known. Little wonder that some people cannot cope. Our challenge now is to ensure that we be informed and sensible stewards of this planet and all its life.

Questions for Discussion

1. How did air quality 50 years ago compare to air quality today?
2. What are some common household appliances today that did not exist 50 years ago, or in some cases 20 years ago?
3. How does medical care today compare to the medical care of 50 years ago?
4. Has the rate of improving the way people live been increasing or decreasing during the past several years?
5. What are some ways that life is worse than it was 50 years ago?
6. Would you rather live today or 50 years ago?
7. Do increases in knowledge and technology appear to make life better or worse?

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LESSON THREE
OWN IT OR LOSE IT

BACKGROUND

This lesson focuses on a single important economic concept: people are more likely to take better care of the things they own and value. Because people pay the costs of ownership, those who own things expect to receive the benefits. Because they want to receive the benefits, they generally try to make wise use of their property. Other lessons in this unit illustrate how private ownership of resources can contribute to environmental solutions. Many environmental problems result from lack of ownership; in an environment that nobody seems to own, people are not rewarded for wise stewardship of the environment.

ECOMYSTERY

Why do free goods disappear so quickly?

ECONOMIC REASONING

Private ownership of property creates incentives to use resources more wisely than when property is publicly owned. The 1990s have seen the collapse of state-directed economies in Eastern Europe and the former Soviet Union. Nobel Laureate Milton Friedman (former professor of economics, University of Chicago, and currently senior fellow at the Hoover Institute) says there are three keys to economic progress in that area: "privatization, privatization, privatization."

James Gwartney, professor of economics, Florida State University, and Richard Stroup, professor of economics, Montana State University, and senior associate, Political Economy Research Center (PERC), give four reasons why private property will be more wisely used than public property. "First, private ownership encourages wise stewardship." If private owners fail to maintain their property, it will lose value. If they do maintain it, it will gain value. "Second, private ownership encourages people to develop their property and use it productively." Productive use increases the wealth of the owners. "Third, private owners have a strong incentive to use their resources in ways that are beneficial to others." If they use their property in ways other people find attractive, the value of their property will increase. "Fourth, private ownership promotes the wise development and conservation of resources for the future." For example, because private owners of forests will want future income from their land, they will balance present use with future use. That is why most forest owners replant trees and most farmers protect their soil.

On the other hand, when property is owned by government or commonly owned by a large number of people, the incentive to take care of it is reduced. For example, many people argue that public housing is a mess. And many visitors to our public parks deplore the conditions they find there. In these cases the problem may seem to be that we do not work hard enough to maintain our public places. But the principles of economics indicate that we should expect difficulties to persist when property is not privately owned because the incentives for government are different from the incentives for private owners.

ECONOMIC CONCEPTS

Incentives
Private Property

OBJECTIVES

1. Students describe how private ownership encourages the wise use of resources.

2. Students contrast the incentives created by public ownership with the incentives created by private ownership.

TIME

One class period

MATERIALS

- Visuals 7 and 8
- A bag of candy with at least one piece of candy for each student

PROCEDURE

A. Bring to class a bag of candy—M&Ms or Hershey's Kisses. Tell students to pass the bag around the room and take what they want. Don't set any rules.

B. The bag probably won't make it all the way around the room. Some students will get no candy, and they will complain even though there was enough for everyone at first. Ask why everyone didn't share the candy equally. If the class *did* share the candy, ask why in another, some students might have taken more than their share. Students may give many responses. Write the responses on the chalkboard, but don't evaluate them.
Display **The Principles of EcoDetection** and explain that today's lesson concentrates on developing a good understanding of principle 4.

C. Ask students how they would treat candy if they owned it.
(Expect all kinds of answers, but the key is that they would control its use and would use it in their interest.)

D. Ask why owners of candy companies make candy.
(They eventually want to sell it and make a profit.)

E. Ask students if candy companies would make candy if they could not benefit from ownership—if people could just take the candy without paying for it. (No.)

F. Now return to the chalkboard and discuss other ways in which you might have distributed the candy. For example, you could have charged a price for the candy. Evaluate the arguments, but conclude that if you own the candy, you can control its use. Ownership provides rewards that encourage us to take care of property.

G. Display Visual 7 and discuss the questions. Stress the contrast between private and public ownership and show that people generally take better care of things they own and value.

H. Discuss the first example given in Visual 7. This discussion should be open-ended and free-wheeling. In the discussion, you might bring up the costs and benefits of littering. People litter because it reduces their waste-disposal costs, although it imposes costs on others. If you own the property, littering imposes costs on you, and you are less likely to do it. For example, most homeowners would quickly pick up litter in their yards. On the other hand, values differ, even among individual property owners. Some students may be sloppy, and their living rooms may look worse than the school's corridors.

I. Discuss example 2 in Visual 7. It should reinforce example 1.

J. Discuss example 3. It is designed to suggest a different concept. We generally take better care of the things we value. For example, a student may own a bicycle and a tricycle. The student doesn't care much about the trike because he or she no longer uses it. The bike is more important, and the student takes better care of it. Of course, the student may want to take good care of the trike in order to sell it. You could relate this point to ownership by asking students whether they would take better care of a bike they own or a bike they may rent on vacation.

K. Discuss example 4. It reinforces example 3. Young people's rooms are usually messy because they don't value cleanliness as much as adults do. Nevertheless, children do value the stuff in their rooms a lot. The stuff in their rooms belongs to them, while the things in the rest of the house belong to their families. When families clean the room, they may move or throw out the child's precious possessions. In this case, families are not taking care of these possessions as well as the child would.

CLOSURE

Project Visual 8 and ask students to solve the mystery. The use of free goods costs the user no money. If someone owns the good, he or she has to pay costs and so uses the good more wisely in order to preserve its value. People generally tend to take better care of things they own because they receive rewards from that ownership and also must pay the costs of that ownership.

ASSESSMENT

Multiple Choice

1. Why do people generally take better care of things they own and value?
   a. They are selfish and greedy.
   *b. They receive the benefits of ownership.
   c. The government requires them to take care of things they own.
   d. Owners are usually rich so they can more easily afford to take care of things they own.

2. Who would take the best care of a house?
   *a. Private owners, because they want to increase the property's value.
   b. The government, because it cares about citizens' property.
   c. Renters, because they usually pay very high rents for the house and want to get their money's worth.
   d. A nonprofit organization, because it does not have to make a profit on the house.

Essay

Would you expect to find more litter on a public (government-owned) beach or on a beach that is owned by a hotel?
(People generally take better care of things they own and value. The hotel will lose customers if its beach is dirty. The hotel receives income from the beach, so it has an incentive to treat it well. Although some governments would also take good care of the beach, government agencies may have different incentives because they do not own the beach. Since the city or county government doesn't usually receive income from the users of the beach, taxpayers may not want to spend a lot of money keeping the beach clean. Emphasize that monetary interests are not the only incentive and that public ownership can and does work. However, other direct controls must replace profits as an incentive if government ownership is to work.)

Journal

What steps do you take to protect things you own? For example, how do you protect your bike from theft? Why do you do this?

VISUAL 7
YOUR SCHOOL, YOUR HOME, AND YOUR STUFF

1. Which is cleaner: your school's corridors or your living room? Why?

2. Which is cared for better: your kitchen (or dining room) or the school cafeteria? Why?

3. Which stuff that you own do you take very good care of? Which stuff that you own do you not take such good care of? Why?

4. How does the way you clean your room differ from the way your family cleans your room? Why?

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

VISUAL 8
ECOMYSTERY: THE FREE GOOD

Why do free goods disappear so quickly?

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

LESSON FOUR
THE ENVIRONMENT: WHO LOVES YA, BABY?

BACKGROUND

Most people are in favor of taking good care of the environment. When people do damage to the environment, the damage most likely does not mean that person wants to do harm. Instead, he or she most likely is responding to another incentive. To correct environmental abuse, one has to eliminate or change the reason people have for abusing the environment in the first place. For example, if people do not want others to create open-pit mines, then people must change the demand for the ore that is being demanded or find a less costly way to mine the ore so that open-pit mining becomes less attractive.

ECOMYSTERY

Why do people destroy the environment they love? Montana and West Virginia boast some of the most beautiful mountains in the United States. Yet in both states, open-pit mines destroy the beauty that most of the mine workers and owners love and use for recreation. Why do they help destroy the land they love?

ECONOMIC REASONING

Mining is an example of an activity people choose to engage in even though they know it will change the environment. They choose to change the environment because they are influenced by a unique set of incentives and costs. The public's demand for coal provides income for people who extract coal ore from the earth. This income is an incentive to everyone working in the coal industry. The cost of open-pit mining is lower than the cost of other types of mining that do less damage to the environment. When there is no incentive to use a less-damaging method of extraction, companies will choose to mine coal in open-pit mines.

ECONOMIC CONCEPTS

Incentives
Opportunity Cost
External Cost

OBJECTIVES

1. Students identify the opportunity cost of mining that does not disturb the surface of the earth.

2. Students explain the incentives that encourage open-pit mining.

3. Students evaluate the consequences of requiring miners to work without disturbing the surface of the earth.

TIME

One class period

MATERIALS

- Two clean, neatly organized classrooms with many chairs, desks, and tables
- Two large containers of black beads
- A large bowl of M&M candies
- Visuals 9 and 10

PROCEDURE

Before teaching: Classroom preparation
This lesson will work best if done with another teacher and class so that you can use two classrooms. Be careful to clean and organize each classroom before starting this lesson. Have every chair in place, every book arranged; if you can arrange to do so, place some flowers and plants in the rooms. Have all students in one classroom to begin the lesson. The crowded conditions will help the activity succeed.

A. Display Visual 9. Start the lesson by asking students if they like beautiful, untouched places such as mountains and forests. Encourage them to explain why they appreciate such places (usually they will comment on clean air, no trash, no loud noise, beautiful plants). Do not prolong this discussion, but attempt to collect and record some examples on the chalkboard for later discussion and comparison. Stress that nearly everyone loves the environment.

B. Explain that open-pit mining means removing the earth's surface in order to extract resources buried near the surface. Open-pit mining is often used to extract coal and iron ore. States with extensive open-pit mines include Montana, West Virginia, Wyoming, Indiana, and Ohio. Display Visual 10. Ask students to guess why people would choose to destroy the beautiful countryside in such states as West Virginia and Montana. Allow a variety of responses—people do it for money, people are weird, people don't care about the environment, people don't know any better, and so forth.

C. Display **The Principles of EcoDetection**. Remind students that people's choices influence the environment and that rewards influence environmental decisions. Explain that you are going to conduct an experiment with them that might help them to solve this mystery.

D. Ask students to watch carefully while you toss black beads around the room; tell them they are not to do anything until they receive further directions. Toss the beads around the room in what looks like a random fashion, but be sure to have some beads go under chairs, tables, into the plants, and other difficult places to reach.

E. Tell students that they soon will have an opportunity to pick up these beads. You will give them one M&M for every bead they collect in one minute. They are to work alone on this task. **It is not a group activity!**

F. Give them one minute to collect their beads. Be careful. The students may become noisy as they move around the room. Desks and tables might be moved as students search.

G. Calculate the total number of beads collected. Give students the M&Ms as agreed.

H. In their search for beads, the students will likely disturb the classroom environment by pushing things aside, moving tables out of the way, and so on. Ask the students how they can justify the changes they have made to the environment of the room. Why have they made a mess of an area that was neat and well-organized before they arrived? (They will reply that they didn't know they should keep it clean, that they tried but others destroyed it, that they didn't care because they wanted the M&Ms, or that it wasn't their classroom.)

I. Display Visual 10 and direct the students' attention to the definition of incentive. Ask students what incentive motivated them. (The opportunity to gain M&M candies.)

J. Now, direct the students to the definition of external cost. Ask: Who pays the external cost of their bead-gathering activity? (Whoever has to clean it up later. They probably figured the teacher or janitor would pick things up later and make the rooms tidy again.)

K. Ask: Based on your experience gathering beads in return for M&Ms, why do you think mine owners create open-pit mines?
(Income serves as an important reward for mine owners and workers. Moreover, they don't have to clean up the mess. When the operation is complete, they can move on to a different area.)

L. Run the bead-search activity a second time, but explain to the class that no one can pick up a bead until the area has been restored to its previous condition. They have one minute to use for cleaning up the room and searching for beads.

M. Calculate the number of beads collected and give out the M&Ms. Ask students what was the consequence of restoring the environment?
(Lost production of beads.)

N. Display Visual 10 again and direct the students to the definition of opportunity cost. Help students see that a fixed set of resources (their labor) can not be used productively for two different activities at the same time. For example, the opportunity cost of watching a TV program might be homework not done. Or, the opportunity cost of babysitting on Friday night might be a pizza not enjoyed with friends. All choices involve an opportunity

cost. When a company chooses to restore the environment, it bears the cost of lost production. When it produces by means of open-pit mining, it bears the cost of environmental destruction. Every environmental action involves a cost. Good decision makers attempt to make choices in which the benefits outweigh the costs.

CLOSURE

Take students to the second classroom. Again toss the beads around the room and have them collect the beads for M&Ms, but this time require that they do not disturb the current environment. There will be a severe penalty (50 beads) for any disturbance of the environment, and any student caught in the act will have to restore the room to its original condition before returning to bead collection. After one minute, count the number of beads collected, give students their M&Ms, and ask them to summarize how this experience is similar to the previous experience by answering the following questions:

1. What was the incentive to collect the beads?
   (The M&Ms.)

2. What was the incentive to protect the environment?
   (Avoid the penalty.)

3. What was the opportunity cost of protecting the environment?
   (Lower collection totals than in the first round in the other classroom.)

4. Were there external costs in this situation?
   (No, because students would have to restore any damage done and pay the fine. The cost is now internalized.)

ASSESSMENT

Multiple Choice

1. Which of the following answers does not describe an incentive to preserve the environment?
   a. Earning a "Saving the Environment" award at a job.
   b. A personal love of the outdoors.
   c. People will pay you to enjoy an unspoiled area you own.
   *d. A stranger complaining that "you people" are stupid to destroy your environment.

2. Which of the following examples describes an external cost?
   a. A pedestrian breathing car exhaust.
   b. Fish killed when a truck accidentally spilled toxic materials into a lake.
   c. Airplane noise heard by school children in a school near an airport.
   *d. Answers a, b, and c all describe external costs.

Essay

An environmental group proposed to close a paper mill in town because the mill emits a smell like rotten eggs. The City Council rejected the proposal because the opportunity costs were too high. The members of the environmental group did not understand the term, "opportunity costs." Write a short essay explaining the term and telling how it applies in this example.
(Opportunity cost is the next best alternative to any given choice. In this case, the group's choice—close the plant—means all the workers would lose their jobs and their incomes, plus the city would lose the tax revenue that the paper mill pays. It seems like a very high cost to pay to reduce a smell. Maybe somebody could propose a way to correct the situation without requiring the mill to close.)

Journal

Observe the streets where you live. Which streets are cleanest and which have the most trash on them? Can you identify any incentives which might explain this difference?

VISUAL 9

ECOMYSTERY: WHY DESTROY WHAT WE LOVE?

Why do people destroy what they love? In parts of Montana and West Virginia are some of the most beautiful mountains in the United States. Yet, in both states, open-pit mines destroy the beauty that most of the mine workers and owners love to use for recreation. Why?

From *Economics and the Environment: EcoDetectives*. © National Council on Economic Education, New York, NY

VISUAL 10
DEFINITIONS

Incentive
An anticipated reward from making a choice.

External Cost
A cost paid for by people who are not part of the exchange between buyer and seller.

Opportunity Cost
The best alternative not chosen.

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LESSON FIVE
HOW CLEAN IS CLEAN ENOUGH?

BACKGROUND

Cleanliness has become a major environmental controversy. People tend to agree that we should have clean air and water, but they often disagree about how clean is clean enough. Does clean water mean no acidity in the water when a lake has natural acidity because of its geological location? Does clean air mean no emissions from automobiles? Or does clean air mean emissions are okay as long as winds blow the emissions elsewhere? Economists who have studied this issue suggest an approach that focuses attention on the costs as well as the benefits of cleaning up the environment.

ECOMYSTERY

Can the air and water become too clean?

ECONOMIC REASONING

In a world with scarce resources, efficient use of those resources is an important goal. Inefficiency is a waste of resources that could be used for other desired outcomes. The goal of efficiency suggests that cleaning the environment should continue as long as the benefits we gain from additional cleanliness are greater than the costs we pay to produce additional cleanliness.

Any time we set out to do a big cleanup job, the first stages of our work will be more efficient than the later ones, because a few cleanup resources can yield large benefits. For example, cleaning up a lake by restricting the flow of sewage from one factory is easy to accomplish and can dramatically improve the lake's water quality. But replacing all septic tanks near the lake with a community sewage system would cost much more—and the extra expenditure would be less efficient. To make the lake water 100% clean by installing a filtering system to clean the runoff water from every rainfall would be extremely expensive and would yield few obvious benefits to most people who care about the lake.

Balancing additional costs against additional benefits is a helpful criterion to use when attempting to resolve issues of cleaning the environment.

ECONOMIC CONCEPTS

Efficiency
Costs
Benefits

OBJECTIVES

1. After participating in a cleaning demonstration, students establish criteria for evaluating environmental cleanup proposals.

2. Students use cost-benefit criteria to evaluate proposals to clean the environment.

3. Students explain why acceptable levels of environmental quality differ from situation to situation.

TIME

One class period

MATERIALS

- Visuals 11 and 12
- Dirty rug squares: You will need at least one rug square for the instructional activity described in Procedure D. If you choose the **small group method** described in Procedure D, you will need one rug square for each group. Rug samples are usually available without cost from carpet sellers. Get the largest available pieces so that students will have plenty of rug area to clean. Do things to make the rug pieces very dirty. Grind in lots of dust, coffee grounds, sand, toast crumbs, and dried, crusted milk residue. Pour coffee and grape juice on the rug to stain it. Then litter the rugs with small scraps of paper, leaves, paper cups, and so on.
- Hand-held vacuum cleaners or whisk brooms, trash bag.

PROCEDURE

A. Explain that cleaning the air and water is an important environmental issue. But why should it be an issue? Doesn't everybody want clean air and water? Today we are going to conduct a classroom experiment to see if

we can understand one reason why this issue has become controversial.

B. Display Visual 11. Ask: Which statement would you agree with?
(Most students will favor statement 1. Poll the students informally; do not try to influence their decisions. Encourage the students to justify their preference. Their explanations may help to generate controversy.)

C. Display Visual 12. Invite students to speculate on reasons why the air can or can not be too clean.

D. Conduct an experiment with the class. Explain that the experiment will help students understand problems related to cleaning the air and will suggest practical ways to deal with air pollution. This experiment can be conducted in one of two ways, depending on how much students are involved.

1. **Demonstration Method** Organize a demonstration in which 3 to 5 students participate directly and the remaining students look on. This procedure reduces management tasks for the teacher.

2. **Small Group Method** Divide the class into small groups; each group will perform the experiment and compare results. This procedure engages more students directly in the activity but requires more set-up and management by the teacher.

The directions are written to assist the teacher with either procedure.

E1. **Demonstration Method:** Choose 3 to 5 students to clean a single dirty rug (see materials section for suggestions on how to prepare the dirty rug). Arrange the classroom desks so that the demonstration group is in the center of the room, surrounded by the observing students. Follow the remaining procedures as described in E2.

E2. **Small Group Method:** Divide the class into groups of 3 to 5 students. Give members of each group a dirty rug square, a trash bag, and a hand-held vacuum cleaner or whisk broom. Tell them they will have 30 seconds to clean the rug square. The rug cannot be moved. It must stay on the floor in the position in which they found it. All trash must be placed in the trash bag. One person should write a description of how much cleaning is accomplished in 30 seconds. The group that gets its rug clean first gets an extra five points on their next quiz.

F. Begin round 1. Give the group(s) 30 seconds to clean the rugs. Ask the recorder to describe what cleaning took place. Record the information on the chalkboard for each group.
(Group members probably picked up the easiest litter to gather and quickly vacuumed or brushed the rug.)

G. Ask the students if they think their rug is clean.
(Most will say no. They didn't have enough time.)

H. Begin round 2. Give the students another 30 seconds to clean their rug. Again, ask the recorder to describe the cleaning that takes place. Record the information on the chalkboard for each group.
(They probably will clean up the next-easiest material to collect from the rug.)

I. Ask students if they think their rug is clean.
(Some may think it is. If so, ask if they think other people will think the rug is clean. Most will still think it is not clean.)

J. Begin round 3. Give the students another 30 seconds to clean the rug. Again, ask the recorder to describe the cleaning. Record the information on the chalkboard for each group.
(It should be getting harder to clean up the rug any more—to get it very much cleaner.)

K. Ask students if their rug is clean.
(More will say "yes" at this point. They are probably tiring of the experiment by now. If not, conduct more rounds until they do think the rug is clean.)

L. Explain that you do *not* think the rug is clean. You think that they should continue to clean

the rug in order to earn the extra points on the next quiz. Students may protest and question your evaluation. *Prove* that the rug is not clean by picking it up and hitting it sharply with your hand or a ruler. Dust will fly out of the rug. Ask: Why did you think the rug was clean when dust is still in the rug? Record the students' replies on the chalkboard. (Some of their comments should include "it's too hard to clean the whole rug" or "it's clean enough to suit us" or "we don't have the right equipment to clean all the dust and stains from the rug.")

M. Display Visual 11 again. Which statement most resembles the students' protests about cleaning the rug?
(Statement 2—the one many students disagreed with at the beginning of the lesson.)

N. Ask:

1. When was cleaning the rug easiest?
(In the first rounds.)

2. When did you see great improvements in cleanliness?
(In the first rounds.)

3. When it was most difficult to get the rug cleaner?
(Cleaning was most difficult in the last round, when all the obvious litter and easy-to-extract material had been removed.)

4. Is it possible to get the rug still cleaner? How?
(Yes. With cleaning fluids, soap, brushes and hard scrubbing it will be possible to get the rugs cleaner.)

5. Can something be *too* clean?
(It depends. We need to ask, "too clean *for what*?" For some purposes, more cleaning of the rugs would not be worthwhile. We could use them right now, for example, for padding in the back of a pickup truck. If that's what we want to do with the rugs, we wouldn't gain any benefit by spending more time and money to do additional cleaning. More cleaning would be inefficient.)

O. Explain this criterion for use when evaluating how clean is clean enough: *Something is "clean enough" when the benefits of additional cleaning are less than the costs of additional cleaning.* Encourage the students to recognize that this is the criterion they used when they participated in or watched the rug-cleaning experiment. They discovered from the experiment that, at a certain point, the costs of further cleaning far outweighed the benefits.

P. Display **The Principles of EcoDetection**. Ask: What principle of ecodetection best explains why people analyze additional benefits and costs? (People's choices are influenced by rewards. In the rug example, students saw that when additional costs offset additional benefits or rewards, people will not support additional cleanup.

Q. Ask students to apply this lesson on rug cleaning to cleaning the air and water. How clean should air and water get?
(Encourage students to recognize that obtaining 100% clean air and water would require very high costs. The potential costs of air and water cleanup need to be weighed against the potential benefits of cleanup. That cleanup costs should be less than the cleanup benefits is a useful criterion to aim for.)

CLOSURE

Ask students to apply the cost-benefits criterion to other environmental problems, such as the environmental quality of their rooms at home. Ask: Why do most parents disagree with teenagers on how clean teenagers' bedroom areas should be?
(Teenagers and parents disagree on the criterion to be used in deciding how clean is clean enough. They argue about whether the extra work necessary to make the room cleaner is worth the benefit received.)

ASSESSMENT

Multiple Choice

1. Which of the following statements is false?
   a. Cleaning up the environment requires people to decide how to use resources.

b. Cleaning up all pollution is very expensive.
c. Some pollution may not be worth cleaning up.
d. Resources used to clean up pollution cannot be used for other purposes.
*e. Cost is not an important consideration when cleaning up the environment.

2. When lake pollution is reduced, which part is most difficult to clean up?
a. The first 10% of the dirty material.
b. The pollution which that floats in large chunks on top of the water.
c. The sewage flowing in from one large pipe.
*d. The last 10% of pollution left after 90% of the pollution has been eliminated.

Essay

1. Imagine that your family has given you a choice of cleanup tasks. You can clean up your room 100%. Your family will check it before you are done to be sure it is 100% clean. Or you can clean up two rooms, but if you choose to clean two rooms it will be enough to get them 50% clean. Someone else will finish cleaning the rooms after you have done your part. Which option should you choose if you want to do the least work? Explain how this choice relates to cleaning lakes and rivers. (Students should select option 2. It is much easier to clean two rooms to the 50% level than it is to clean one room to the 100% level. After a room is 50% clean it takes much more time, effort, and equipment to get it 100% clean. Cleaning lakes and rivers presents the same problem. The first level of cleaning is easier to accomplish than the later cleaning needed to get a lake or river *entirely* clean.)

2. Read the following statement. Decide whether the writer's conclusion is accurate. Give examples to support your conclusion.

"There is no reason why we can't get our air and water *really* clean—100%. There is no excuse for a dirty environment, just as there is no excuse for driving a dirty car, cooking in a dirty kitchen, sleeping in a dirty bedroom, or wearing dirty clothes."

(The writer exaggerates the point. None of the examples is accurate. No one's car, kitchen, bedroom, or clothes meet the highest possible cleanliness standards. Individuals keep those items *clean enough* to satisfy themselves. Air and water also can be kept clean enough. They do not have to be kept to the highest possible standards.)

Journal

Over a period of several days, write an entry in your journal to record every time you notice dirt on something of yours. It might be a spot of tomato sauce on your shirt, a big spot on your parents' car windshield, some dust or water spots on your bicycle fender, a candy wrapper on your front lawn, and so on. When you have made several entries, look back over the list and think about what action you took to clean up these spots and blotches. Did you clean every one of them up? Did you do the cleaning right away, or did you wait a while? How clean did you try to get each item? Write a paragraph in which you answer these questions. In your paragraph, comment on the costs and benefits that influenced you.

VISUAL 11
ENVIRONMENTAL STATEMENTS

Statement 1

Spanaway Lake is a disaster. It used to be a beautiful, pristine lake where you could drink the water safely. Now it is dirty from overuse, soil runoff, and overflow from septic tanks. The County Council should clean the lake completely—100% clean. The technology and know-how are available. There is no excuse for not doing the job right.

Statement 2

Cleaning the lake completely is environmental overkill. We don't need it to be perfectly clean. We can clean up most of the problem for one-third the cost and effort it would take to get it "completely" clean. The County Council should not overspend for the environment.

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VISUAL 12
ECOMYSTERY: TOO CLEAN?

Can the air and water become too clean?

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LESSON SIX
HOW CAN WE HELP THE ENDANGERED SPECIES?

BACKGROUND

Several species of animals and plants are threatened with extinction. Examples of endangered or threatened animals include the northern spotted owl, the timber wolf, the black panther, and the grizzly bear. In order to protect these animals, the U.S. Congress in 1973 passed the Endangered Species Act, which requires citizens not to harm the specified animals or their habitats. Any time an endangered animal is found living on private land, the owner is required to stop using the land and leave it for the use of the animal. According to the Act, the cost to the landowner is not to be considered. No compensation is provided for owners if their land must be taken out of production to provide habitat for an endangered species. This policy requires sacrifices on the part of farmers and developers who had planned to use their land for such things as food production or the building of homes.

ECOMYSTERY

Why would people with supposedly good intentions attempt to kill wildlife listed as endangered species?

ECONOMIC REASONING

The theory of the Endangered Species Act is that animals and plants provide a benefit to everybody. Since the public benefits from their enjoyment of plants and animals, individual landowners should not be allowed to harm those plants and animals, even if protecting them requires landowners to hold back on farming, grazing, building, or other activities. As a result, the public receives a benefit that it does not pay for. The costs are borne by the individual landowners. Many landowners resent having to pay these costs for others. If no endangered species were to be found on their land, they would not have to pay the costs. The Environmental Protection Act creates an incentive for landowners to kill or otherwise remove certain animals they find on their property. Most people are influenced by incentives.

ECONOMIC CONCEPTS

Incentives
Costs
Benefits

OBJECTIVES

1. Students describe the effect of changed incentives on classroom decisions.

2. Students explain why people might resist protecting an endangered species.

3. Students propose ways to protect an endangered species by providing positive rewards to property owners.

TIME

One class period

MATERIALS

- Visuals 13 and 14
- Activity 6
- Five small tables
- Eight packages of M&M candies
- 30 small containers of paper clips, each with 18 silver clips and two red clips.

PROCEDURE

A. Explain that the purpose of this lesson is to demonstrate how efforts to protect endangered plants and animals can unintentionally put them into greater danger.

B. Display Visual 13. Explain that each individual was described by friends as a pleasant and kind individual who loved the outdoors and wanted to preserve the environment. Invite the students to describe situations they know about where animals—squirrels, ants, goldfish, cats—may have been killed or hurt by supposedly kind or well-meaning people.

C. Display Visual 14. Invite students to speculate on why some people with supposedly good intentions would want to harm endangered species.

D. To help explain this mystery, tell students that, with their help, you will conduct a class experiment. This experiment will require them to work together in small groups near a table and to follow directions.

E. Distribute Activity 6 to students and explain the directions. Model the collection method described in direction 7. Emphasize direction 12. It will be important to the outcome that students do not feel closely monitored by the teacher when they make their decisions.

F. Place students into five groups near five different tables. They do not have to sit or stand around the table. The table will be used by the collector of paper clips.

G. Choose a student to help the teacher distribute paper clips to each table and to watch informally how the groups conduct their work.

H. Ask students in each small group to decide who will be the collector for the first round.

I. Remind students that they will have 30 seconds to pick up as many paper clips as possible, using only the second and third fingers of one hand.

J. Begin round 1. Stop the activity after 30 seconds. Ask each group representative to bring the paper clips to you. Trade one M&M for each paper clip. Let the students distribute the M&Ms among themselves. Check for any confusion or misunderstanding.

K. Ask students if they noticed the red paper clips. Tell them these clips are rare, and we would like to preserve them so that students in the next class can see the red clips also.

L. Before round 2, ask students as a favor to other classes not to collect red clips. If they do happen to collect a red clip, *it will be accepted and exchanged* for an M&M. Begin round 2. Stop the activity after 30 seconds. Ask each group representative to bring the paper clips to you. Trade one M&M for each paper clip. Let the students distribute the M&Ms among themselves. Check for red clips. Probably some will have been collected and exchanged. If not, imply nonetheless that some groups have been collecting red clips.

M. Get ready to conduct round 3 using the same rules—*but with one exception. In this round, if a group has a red paper clip, somebody from the group must notify the instructor before the collecting begins so that the instructor can set up a protection area for the red clip. The protection area includes all the paper clips within a 1 square-foot area of the red clip. If anybody collects a red clip, it will not be accepted and the group will be fined 20 paper clips. After all red clip areas have been identified and protection zones established, the collecting may begin.*

N. Begin round 3. After 30 seconds, stop the trading, exchange paper clips for M&Ms, and listen to complaints about unnecessary levels of protection. Sympathize with the students, but state that the law is needed to protect red clips for the next classes.

O. Begin round 4 with the same directions as those used in round 3. *Before the round begins, one or more groups will probably decide to hide or do away with the red clips on their table. They will not call the instructor over to set up the protection area. Do not question this behavior. Act as if you are unaware of their actions.* After 30 seconds stop the collection and exchange M&Ms for clips. Express relief that there were no red clips collected in this round. Students should get a chuckle out of this statement since some of them will have removed the red clips distributed to every group with each new batch of clips.

P. Conduct round 5, with one new rule. *In this round any group with a red clip will receive a bag of M&Ms if they do not disturb the red clip and do not disturb the clips lying against it.* All other clips may be collected.

Q. Ask students if any table has a red clip this time. Each group should have at least two, because two were included in each container in preparation for the game. Identify the location of the clips on each table.

R. Begin round 5. Stop collection after 30 seconds. Look to see if the red clips are disturbed. Distribute one bag of M&Ms to the groups that did not disturb the clips. Also give them one M&M for each paper clip collected.

S. Ask students to discuss their behavior and examine the results of the experiment, using the following questions.

1. Why were there no red clips in round 4?
(Students will suggest it was too costly to preserve them. It reduced their collection area too much. And they received little benefit from preserving the red clips.)

2. Why were there several red clips in round 5?
(Students will suggest that it was worthwhile to preserve them in order to get the bag of M&Ms. The benefits outweighed the costs.)

3. Did they see themselves as "good" people even though they behaved very differently, given two different opportunities to preserve red clips?
(Most will see themselves as "good" people; they were merely attempting to respond to the incentives presented to them by the new rules.)

4. What do you think this experiment had to do with the four examples of people destroying endangered species described in Visual 13?
(Students should consider that the cost of preserving those species is very high for those individuals and the benefits very low.)

5. What could be done to help preserve these endangered species?
(Implement programs and rules that reward individuals and groups for preserving the habitat of the endangered species.)

CLOSURE

Summarize the main points of this experiment. Display **The Principles of EcoDetection**. Ask students to explain which principles of ecodetection are best illustrated in this lesson.
(They made choices that influenced the environment. Many choices had unintended consequences. Explain that a law to preserve endangered species might unintentionally put species more at risk if the law imposes too high a cost on individuals affected by the law. People's choices are influenced by rewards. Endangered species may be protected better by providing benefits to individuals who have the opportunity to protect habitats.)

ASSESSMENT

Multiple Choice

1. Which of the following statements is true?
   a. Only evil people would kill a member of an endangered species.
   b. People will help protect endangered species no matter what the cost to themselves.
   c. People will not help endangered species unless the government forces them.
   *d. People will protect endangered species if given positive incentives to do so.

2. Which of the following plans would help preserve the spotted owl nesting area in a private forest?
   a. Require owners of the forest to feed the owl three times a day.
   b. Ask all bird watchers to make room for owl nests in their homes.
   c. Require owners of the forest to not disturb 80 acres of trees around each nest.
   *d. Give the forest owner $10,000 for each undisturbed nest on his or her forest land.

Essay

1. Assume that a law existed to protect one type of dog, such as cocker spaniels. The law states, "anywhere a cocker spaniel is known to be living, the area must be preserved. No changes can be made in that environment, and any human beings living in the area must leave. Any one finding a cocker spaniel living near him must report it to authorities so that the area can be placed off-limits for human occupation." What do you think will happen to the number of cocker spaniels in the country? Explain your answer.

2. Describe a positive way to encourage ranchers

to protect wolves they find on their land. Explain why your method might work better than making the rancher stop using the land for cattle production.

Journal

Find a magazine or TV news report about an endangered species. Describe what actions were taken to protect the endangered species.

VISUAL 13
ENDANGERED SPECIES HEADLINES

1. Nebraska farmer deliberately plows under rare endangered prairie grasses.

2. Northwest logger destroys a spotted owl nest after finding it on his timberland.

3. Montana rancher charged for killing a mother timber wolf and her litter found living on his land near Yellowstone National Park.

4. Florida developer organizes employees to hunt and kill any endangered birds living near a proposed shopping center development.

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VISUAL 14
ECOMYSTERY: THE CASE OF THE ENDANGERED SPECIES

Why would some people with supposedly good intentions attempt to kill wildlife listed as endangered species?

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ACTIVITY 6
EXPERIMENT DIRECTIONS

Name _____

1. Your goal as a group is to collect as many paper clips as you can and trade them for M&M candies.

2. Paper clips can be collected only during timed rounds, supervised by the teacher.

3. Each round will last 30 seconds.

4. There will be several rounds of collection.

5. Only one person in the group can collect paper clips during each round. Others may cheer or offer suggestions.

6. A different student must be a collector in each round.

7. Collectors can pick up only one paper clip at a time, using only their second and third fingers. The use of thumbs, sweeping motions, or tools is not allowed.

8. All new paper clips will be placed on the tables before each round by a student helper.

9. All collection will begin when the teacher says "go" and stops when the teacher says "stop."

10. Any paper clips not collected stay on the table for the next round.

11. After each round a group representative brings the paper clips to the teacher and trades them for M&Ms.

12. All groups pledge on their honor to be honest and accurate in their calculations and to observe the rules.

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LESSON SEVEN
USING REWARDS TO PROTECT ENDANGERED SPECIES

BACKGROUND

Some highly valued animal species decline in population, even to the point of extinction. The buffalo were valued by Native American and white hunters in the nineteenth century. Native Americans used parts of the buffalo for shelter, clothing, and food. They exchanged buffalo products with each other and with whites. Similarly, whites exchanged money for buffalo meat which they used to feed crews building the railroads. Today, African elephants are valued for similar reasons. Ivory from elephant tusks is made into piano keys and carved into chess pieces. Elephants' hides are nearly as valuable; they can be made into boots and wallets.

ECOMYSTERY

Native Americans and whites depended on the buffalo for food and clothing, much as we depend on beef cattle today. Yet the buffalo nearly became extinct. By 1889, only about 150 were left. Today, however, the buffalo are back. Why?

Will the African elephant go the way of the American buffalo? Illegal hunters kill many elephants in several African nations, and the elephant population is endangered. In southern Africa, however, the situation is different. The elephant populations of Zimbabwe, Botswana, Namibia, and South Africa are increasing. Why?

ECONOMIC REASONING

Rewards for killing buffalo were high, while the rewards for protecting them were low and uncertain. It was difficult to establish rules about who owned buffalo. It was too expensive to fence in the herds, and no one could determine who owned free-range buffalo. Since no one owned the buffalo, no one had anything to gain by trying to limit the killing. A buffalo not taken today would be one that someone else took tomorrow. Today, however, private ownership is easily established, and many people wish to eat buffalo meat as an alternative to beef. People who own buffalo protect their herds and increase the size of their herds, so they can sell buffalo for food products.

In Africa, there is a similar development. People tried at first to protect elephants by outlawing elephant hunting and by banning the sale of ivory. But these bans drove up the price for ivory. Higher prices caused risk takers in some nations to decide that the rewards for taking elephants illegally were well worth the costs. Thus, much killing continues. But in southern Africa some nations have tried an incentive approach to preserving the elephant. South Africa, for example, allows safari hunting (gun and photography) and tourism on private and state land for a fee. It also allows the legal sale of ivory and hides. As a result, if South Africans protect the elephant population, they can sell hunting rights, ivory, and hides—and benefit from the sales. Thus they have an incentive to protect elephants.

ECONOMIC CONCEPTS

Incentives
Private Property Rights

OBJECTIVE

Students analyze policy options for protecting endangered species, using the concept of incentives to predict which policies will be effective.

TIME

One class period

MATERIALS

- Visuals 15, 16, 17, and 18
- Activities 7 and 8

PROCEDURE

A. Explain the purpose of this lesson: students analyze protection of the environment, focusing on how rewards can be used to protect endangered species.

B. Explain that, while all of us want a clean school, it is not always clear how best to achieve this goal. Imagine the case of the school hallway. It is dirty. Why? Perhaps it

gets dirty because nobody seems to *own* it. Let's explore that possibility.

C. Display Visual 15. Ask:

1. What are the costs and benefits of picking up paper?
(The cost is the extra effort of picking up paper around your locker. The benefits are cleaner hallways, avoiding paying the fine if you are caught not doing your part, and feeling good for obeying the rules.)

2. Will this policy be a success?
(Maybe. But the benefits of picking up paper are uncertain. Teachers don't have much extra time to spend policing the halls. Weak enforcement means that many students will not comply. Much will depend on how many students do comply voluntarily.)

D. Display Visual 16. Ask:

1. What are the costs and benefits of picking up paper?
(The cost is the extra effort involved in picking up paper around individual lockers. The benefits are the cleanup points that can be redeemed at the auction, plus the sense of feeling good about obeying the rules.)

2. Will this policy be a success?
(Probably. The benefits of picking up paper here are greater.)

E. Explain that the rewards involved in picking up paper in school are similar to the rewards involved in protecting endangered species. While all of us want to preserve endangered species, it is not always clear how best to achieve this goal. Some environmental policies involve high costs and uncertain benefits. Display Visual 17. Ask the class to note that these are only a few of more than 900 species classified by the U.S. government as endangered.

F. Explain that government rules regarding endangered species are simple. It is illegal to do anything that threatens a member of an endangered species. However, sometimes rules of this sort can have unanticipated consequences. Some unanticipated consequences can destroy rather than help endangered species.

G. Display Visual 18. Invite students to speculate on why elephants might be shot illegally or why a rancher would protect a family of wolves.

H. Distribute Activity 7. Divide the class into groups. Working in groups, students complete the reading and prepare answers to the discussion questions. Discuss the questions and the students' responses.

1. Why did Native Americans and whites hunt the buffalo?
(Native Americans used parts of the buffalo for shelter, clothing, and food. Whites used buffalo meat to feed crews building the railroads. Buffalo hides became popular for making robes.)

2. Why did the buffalo nearly become extinct?
(Both Native Americans and whites had difficulty establishing ownership rules for buffalo. Nobody would have benefitted by trying to preserve the buffalo. Buffalo not taken today would be taken by someone else tomorrow.)

3. Why are the buffalo back?
(Most buffalo today are privately owned. Herds are being increased in order to produce meat desired by consumers.)

4. Why are elephants not loved by everybody? Who could hate elephants?
(African elephants are valued by hunters because of their tusks and hides. Farmers don't value elephants because elephants can destroy crops.)

5. Why have bans on the sale of ivory failed to protect elephant populations?
(The bans on hunting and importing have increased the price for ivory. The high price attracted poachers who are willing to take high risks and who had little reason to worry about preserving the elephant population.)

6. What policies have the nations in southern Africa tried?
(South Africa allows safari hunting for a fee. It also allows the legal sale of ivory and hides. The Zimbabwe Department of National Parks and Wildlife Management gives local farmers permission to hunt some elephants and other game. The hunters benefit by gaining meat and hides; the fees paid by the hunters help to support wildlife management services.

7. Why have these policies been more successful?
(The fees from legal sales of hunting rights, and the money to be made by harvesting game, are rewards to local citizens. These rewards give local citizens an interest in preserving the herds of game and keeping poachers out.)

I. Distribute Activity 8. Divide the class into small groups. In each group students should discuss the questions and prepare policy recommendations.

Case 1
Saving the Wolves: *Policy Choice A*

1. What is the policy goal?
(To reintroduce wolves into the western United States.)

2. What are the costs to ranchers?
(They can not use their land in the way they would like to.)

3. What are the costs to tax-paying citizens?
(Very few—the costs are borne by the ranchers.)

4. What are the benefits to ranchers?
(Ranchers who wish to reintroduce wolves will feel good about protecting wolves. Other ranchers will not benefit.)

5. Will the ranchers protect the wolves?
(Given the high costs and limited benefits, probably not.)

Case 1
Saving the Wolves: *Policy Choice B*

1. What are the costs to ranchers?
(They may not use their land in the way they would like to.)

2. What are the benefits to ranchers?
(They are compensated for the wolves' use of their land.)

3. What are the costs to tax-paying citizens?
(Taxpayers would pay for the compensation ranchers receive for letting wolves use their land.)

4. Will the ranchers voluntarily protect the wolves?
(Since the benefits are more advantageous in this option, many ranchers will voluntarily comply.)

Case 2
Saving the Owls: *Policy Choice A*

1. What is the policy goal?
(To preserve the owls.)

2. What are the costs to forest owners?
(They can not use their forest land in the way they would like to.)

3. What are the costs to tax-paying citizens?
(Very few—the costs are borne by the forest owners.)

4. What are the benefits to forest owners?
(Forest owners who wish to preserve owls will feel good.)

5. Will the forest owners protect owls?
(Given the high costs and limited benefits, probably not.)

Case 2
Saving the Owls: *Policy Choice B*

1. What are the costs to forest owners?
(They may not use their forest land in the way they would like to.)

2. What are the benefits to forest owners?
(They are compensated for the owls' use of the land.)

3. What are the costs to tax-paying citizens?
(Taxpayers would pay for the compensation forest owners receive for letting owls use their land.)

4. Will the forest owners voluntarily protect the owls?
(Since the benefits are more advantageous in this option, many forest owners will voluntarily comply.)

CLOSURE

Review key points of the lesson. Ask: What policies are more likely to gain widespread cooperation in the effort to protect endangered species?
(Policies that reward voluntary compliance by providing benefits for the public use of private resources.)

Display Visual 1B again and invite the students to solve the mysteries. Why would poachers kill elephants when the government says not to?
(People are willing to pay for elephant tusks and hides. Also, elephants destroy crops. These facts establish benefits for killing elephants. The bans on hunting elephants and importing tusks and hides do little to reward people for looking after elephants. They only encourage risk takers to take all they elephants they can find.)

Why would some Montana ranchers protect wolves when wolves are predators that destroy sheep and cattle?
(Some private organizations, such as the Defenders of Wildlife, a Washington, DC, environmental group, are willing to compensate ranchers who allow wolves to remain on their land.)

ASSESSMENT

Multiple Choice

1. Why are elephant populations expanding in southern Africa?
   a. Passage of South Africa's Endangered Species Act.
   b. New diseases.
   c. Poor nutrition.
   *d. Policies allowing local people to benefit from the elephant.

Essay

Wetlands are critical to the survival of migrating birds. Ducks, for example, need places to stop along their migration routes from South America to North America. Yet, farmers and land developers often do not wish to preserve wetlands because wetlands preservation reduces their incomes. What are the costs to the owners? What are the benefits? Will property owners voluntarily protect the wetlands? How could incentives be used to encourage farmers and land developers to protect wetlands?
(The cost to the farmers and developers is the income that they would not earn if they protected the wetlands. The benefit to farmers and developers is that they may feel good if they preserve the wetlands. Given that the costs are clear and the benefits weak and uncertain, many landowners will not protect the wetlands voluntarily. However, if some incentive were provided—such as a payment for preserving the wetlands—land owners would be more willing to cooperate. The payment might come from a private organization such as Ducks Unlimited.)

Journal

Identify a problem in school involving students who tend not to take care of things very well because they do not own them. Gym equipment, hallway floors, and corridor walls are possible examples. Write a paragraph explaining how an incentives approach might be used to encourage students to improve their behavior voluntarily.

VISUAL 15
PAPER CHASE 1

The school principal makes the following announcement on the school public address system:

We—the Student Council and I—are no longer willing to tolerate the mess in our hallways.

We want you to know that all students are on their honor to pick up any paper they see around their lockers. Teachers and aides will enforce the policy when they can. If you are caught with paper within 20 feet on any side of your locker, you will be fined $1.00. Proceeds from fines will go to the Student Council Treasury and be used to pay for our year-end dance.

Questions For Discussion

1. What are the costs of picking up paper?
2. What are the benefits of picking up paper?
3. Will this policy be a success?

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VISUAL 16
PAPER CHASE 2

The school principal makes the following announcement on the school public address system:

We—the Student Council and I—are no longer willing to tolerate the mess in our hallways.

Each teacher will be assigned to monitor the section of lockers near his or her classroom. Each teacher will conduct a quick inspection at the end of the day. Students who have no paper or other garbage within 20 feet of their locker at the end of the school day will receive cleanup points that can be used at an all-school auction held each month.

At the auction, students will be allowed to bid on a variety of items such as school supplies, school pennants, paperback books, movie passes, and so on. Students can use their points in any way they wish. For example, points may be traded among the students or saved for future auctions.

Questions for Discussion

1. What are the costs of picking up paper?
2. What are the benefits of picking up paper?
3. Will this policy be a success?

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VISUAL 17
SELECTED SPECIES ON THE U.S. ENDANGERED SPECIES LIST

American Peregrine Falcon

Bald Eagle

Black Caiman (alligator)

Black-Footed Ferret

Brady's Pincushion Cactus

Brown Hyena

Humpback Whale

Jaguar

Florida Scrub Jay

Little Agate Snail

Loggerhead Sea Turtle

Noonday Snail

Northern Spotted Owl

Nine-Banded Armadillo

Queen Alexandra Birdwing Butterfly

Red Howler Monkey

Rice Rat

Small Whorled Orchid

Snow Leopard

West Indian Manatee

Florida Panther

Whooping Crane

Wild Yak

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VISUAL 18
ECOMYSTERY: THE CASE OF THE ENDANGERED SPECIES

The Elegant Elephants Mystery

Elephants are elegant animals. They are an important part of the natural environment of Africa and are protected by many national and international laws that ban the sale of ivory. But some people continue to kill elephants. Why would people kill elephants when the government says not to?

The Wonderful Wolves Mystery

Wolves are wonderful animals. They were an important part of the natural environment in early American woodlands and in the West. But wolves are predators; they kill livestock owned by ranchers and farmers. Moreover, the government is not willing to compensate ranchers for any livestock lost to wolves. Yet, some Montana ranchers protect wolves—known predators that destroy ranch livestock. Why?

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ACTIVITY 7
INTERNATIONAL SPECIES PROTECTION COMMISSION

Name _____

You have been appointed to serve on the International Species Protection Commission. The purpose of the commission is to give advice to national leaders on how best to preserve endangered species.

The commission has often been praised for its clear analysis of problems. The success of past commission efforts can be explained by the fact that it follows the rules of ecodetection when examining policy recommendations:

1. People's *choices* influence the environment.
2. People's choices have *unintended* results.
3. People's choices are influenced by *rewards*.
4. People are more likely to take better care of things they *own and value*.

People's voluntary choices can improve the environment. But because all choices involve costs, people need rewards to encourage them to act voluntarily in ways that will protect the environment. If people can benefit from protecting endangered species, then they will be willing stewards of the environment. If people are punished for the uses they make of their property, then they may respond in ways we would not expect, and these responses might be harmful to the environment. The rewards in question can be provided by laws passed by governments.

Your Job

Read and discuss the case studies prepared by your staff on the buffalo and the elephant. Then you will be asked to make recommendations on new policies.

The Bust of the Buffalo?

The buffalo offered a lot to Native American and white hunters. Native Americans used parts of the buffalo for shelter, clothing, and food. They also exchanged buffalo products with one another and with whites. Similarly, whites were interested in exchanging money for buffalo meat which they used to feed crews building the railroads. Moreover, buffalo hides became popular for making robes.

Native Americans and whites depended on the buffalo for food and clothing, much as we depend on beef cattle today. Yet, the buffalo nearly became extinct. The buffalo population in 1889 had declined to 150.

The buffalo were big, strong, tough animals who migrated across the plains from one Native American hunting territory to another. Unable to restrict these wanderers and thus establish ownership, Native Americans had little to gain from preserving them. If a hunter from one group did not shoot a buffalo, one from another group might. Moreover, the other hunters might be enemies. No rewards encouraged Native Americans to preserve the buffalo. Whites faced a similar situation. Rewards for taking the buffalo were high. Buffalo provided a cheap source of food for crews building the railroads and they provided popular material for clothing. But, it was difficult to establish ownership rules. It was too expensive to fence in the herds, and nobody could determine who owned free-range buffalo. Since no one owned the buffalo, nobody would benefit by limiting the killing. A buffalo not taken today would be one that someone else took tomorrow.

Today, however, the buffalo are back. Property rights for the buffalo now are clearly defined. Most buffalo today are raised on private ranches. They no longer roam the prairie, unclaimed. What is happening to the current buffalo population? It is rebounding. Privately owned buffalo are estimated to number about 130,000. Why are the buffalo back? Private owners of buffalo are

ACTIVITY 7 (continued)

building up herds in order to produce meat desired by consumers who know that buffalo meat contains fewer calories and less cholesterol and fat than does beef.

Questions for Discussion

1. Why did Native Americans and whites hunt the buffalo?

2. Why did the buffalo nearly become extinct? (Hint: what were the rewards to preserve the buffalo?)

3. Why are the buffalo back?

The End of the Elephants?

African elephants are valued because of their tusks. Ivory from the tusks is made into piano keys and chess pieces. Elephants' hides are nearly as valuable. Hides can be made into boots and wallets. But not everybody loves elephants. Elephants in the wild are not good neighbors. Poor African farmers, for example, do not welcome elephants who stomp on their crops.

Elephants are valued for their ivory and hide and hated for the damage they do to crops. It is not a surprise that they are being hunted into near-extinction in parts of Africa. What should be done? In an effort to reduce the ivory trade and protect the elephants, Kenya has banned the hunting of elephants. Moreover, many nations ban the import of ivory.

What has the result of these actions been? Unfortunately for the elephant, the populations have continued to decline. Why? Illegal hunters—poachers—have stepped up their activities. The bans on hunting and importing have increased the price for ivory. The chance of making a great deal of money in the illegal ivory trade has attracted risk takers—people willing to risk being shot in return for the chance to make a great deal of money. These hunters have little reason to worry about preserving the elephant population. An elephant that gets away is just one that some other poacher might kill.

In southern Africa, the situation is different. The elephant populations of Zimbabwe, Botswana, Namibia, and South Africa are increasing. Governments in these countries have followed different polices. South Africa, for example, allows safari hunting (gun and photography) and tourism on private and state land for a fee. Until an international treaty banned trade in ivory, it also allowed the legal sale of ivory and hides. The sale of hunting rights and animal products gives South Africans a reward for looking after elephants.

Zimbabwe has followed similar polices. For example, the Zimbabwe Department of National Parks and Wildlife Management gives local farmers permission to hunt a certain number of elephants and some other game. The local farmers can hunt the animals themselves or sell the hunting permits to commercial hunters. The profits gained through the use of these permits reward local farmers for preserving the animals and for keeping poachers out.

Questions for Discussion

1. Why are elephants loved? hated?

2. Why have bans on the sale of ivory failed to protect elephant populations?

3. What have been the polices of nations in southern Africa?

4. Why have these policies been more successful?

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ACTIVITY 8
POLICY ANALYSIS

Name_____

The International Species Protection Commission uses the principles of ecodetection to guide it in recommending actions to be taken by governments. Review the principles below. Then read the following two cases, discuss the questions, and make your recommendations.

The commission has often been praised by environmental groups for its clear analysis of problems. The success of past commission efforts can be explained by the fact that it follows these rules of ecodetection when examining policy recommendations:

1. People's *choices* influence the environment.
2. People's choices have *unintended* results.
3. People's choices are influenced by *rewards*.
4. People are more likely to take better care of things they *own and value*.

Case 1
Saving the Wolves
Policy Goal: Wolves once lived in many places in North America. They were driven into near extinction because they damaged livestock and pets. Environmentalists wish to reintroduce wolves to the western United States. Today, wolves would help balance the ecology. In Montana, for example, wolves would help control the populations of deer and elk, which now overgraze the land.

Policy Choice A
When wolves are discovered on private property, require ranchers to protect the wolves. For example, ranchers should not come close to the wolves or harm them in any way.

1. What is the policy goal?
2. What are the costs to ranchers?
3. What are the costs to tax-paying citizens?
4. What are the benefits to ranchers?
5. Will the ranchers protect the wolves?

Policy Choice B
When wolves are discovered on private property, pay the rancher $5,000 for not using the land occupied by the wolves and for any risk the wolves present to the ranchers' livestock.

1. What are the costs to ranchers?
2. What are the benefits to ranchers?
3. What are the costs to tax-paying citizens?
4. Will the ranchers voluntarily protect the wolves?
5. Which policy do you recommend? Why?

Case 2
Saving the Owls
Policy Goal: Government biologists have discovered a rare owl that lives in certain types of trees in the western United States. The government would like to protect this owl species.

Policy Choice A
When owls are discovered on privately owned forest land, require the owner to protect the owl. For example, the land owner may not harvest any trees within 20 miles of the owls' nest, or harm the owl in any way.

1. What is the policy goal?
2. What are the costs to the forest owners?
3. What are the costs to tax-paying citizens?

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ACTIVITY 8 (continued)

4. What are the benefits to the forest owners?

5. Will the forest owners voluntarily protect the owl if they discover the owl before the government does? Why or why not?

6. Which policy do you favor? Why?

Policy Choice B
When owls are discovered on privately owned forest land, pay the land owner for not using the land around the nest. For example, pay the owner $5,000 at the end of each year when a nest on the land has been successfully preserved.

1. What are the costs to the forest owners?

2. What are the benefits to the forest owners?

3. What are the costs to tax-paying citizens?

4. Will the forest owners voluntarily protect the owl if they discover the owl before the government does?

5. Which policy do you favor? Why?

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LESSON EIGHT
THE COSTS AND BENEFITS OF HAVING CHILDREN

BACKGROUND

In recent years, many claims have been made about the harmful effects of a growing population on the environment. In its January 2, 1989, cover story on "The Planet of the Year," for example, *Time* magazine wrote that "prospects are so dire that some environmentalists urge the world to adopt the goal of cutting in half the earth's population growth rate during the next decade." But not all nations are experiencing population growth. Birth rates in Western Europe and Japan are below replacement levels. Birth rates in many poor nations, however, remain relatively high. This lesson helps students discover the incentives which influence birth rates in different countries.

ECOMYSTERY

Why do people in poor nations have more children than people in rich nations?

ECONOMIC REASONING

In 1798, Thomas Robert Malthus wrote an anonymous 50,000-word book entitled *An Essay on the Principle of Population as It Affects the Future Improvement of Society*. It was a shocker. In this book Malthus said that the population of the world was exploding geometrically, while the food supply increased arithmetically. Output of food could not keep up with population, and the world faced disaster.

Modern Malthusians still predict disaster unless we drastically change our behavior to limit population growth. Most of these predictions are based on the power of compounding. Population compounds like interest. Just as you receive interest on your interest in a savings account, for example, population growth gets added on to previous population growth. For example, if the population is 1,000 people and the annual population growth rate is 5%, the next year there will be 1,050 people (1,000 x 1.05 = 1,050). If the 5% annual growth rate continues, however, then in the third year the population will be 1,102.5 people (1,050 x 1.05 = 1,102.5). A shorthand way to find out how long it takes population to double is to divide the annual rate of population growth into 70 (70/5 = 14 years for the population to double at a 5% annual growth rate). Surely, the modern Malthusians argue, we have too few resources to feed, house, and clothe this booming population.

But this analysis assumes that population growth will continue at a fixed rate and that there are no positive benefits to population growth. Population growth is much higher in developing countries than in developed countries. This is because in developed countries the opportunity costs of having children are greater while the monetary benefits are fewer. In a developing country, children are needed to take care of their parents as the parents get older. This is not as true in developed countries.

In developing countries, the opportunity cost of rearing children is less than in developed countries if one parent (traditionally the mother) does not have well-paying job alternatives. If the parent will be home anyway, the child care costs are much lower in a developing country. Economists assume poor people are much like people with higher incomes. When poor people have the opportunity to earn good incomes, they will tend to have fewer children. This phenomena has been observed in many different countries and cultural groups as countries change from undeveloped to developed.

ECONOMIC CONCEPTS

Benefits
Opportunity Cost
Rewards

OBJECTIVES

1. Students compare statistics describing the birth, life-expectancy, and infant-mortality rates in developing countries with statistics describing those rates in developed countries.

2. Students evaluate arguments about the effect of

population growth on our capacity to produce an adequate food supply and protect the environment.

3. Students analyze the relationship between economic growth and birth rates.

4. Students discuss the costs and benefits of population growth.

TIME

One class period

MATERIALS

- Visual 19
- Activity 9

PROCEDURE

A. Explain to the class that the purpose of this lesson is to examine the costs and benefits of having children. Ask the students what they think it costs their parents to raise them. Entertain all kinds of answers; make a list on the chalkboard.

B. Tell students that their suggestions probably ignore an important cost—the *opportunity costs* of raising children. Parents have limited amounts of time and income. The opportunity cost of time spent with children might be income not earned at work, meals not prepared, fun not had with adult friends, or household work not done. One or both of the parents in any given family may have refused a new job because they were too busy raising a child. One parent in any given family may not work or may have taken leave from work to raise a child.

C. Ask students how their parents benefit from raising them. Entertain several answers, but emphasize non-monetary benefits such as enjoying children's company, being proud of their achievements, and children keeping the parents feeling young.

D. Display Visual 19. Entertain any explanations of the mystery; write the answers on the chalkboard. Tell students that they are going to do research to determine the answer to this mystery.

E. Give each student a copy of Activity 9 and explain the statistics on it.

1. *Population density per square mile* is determined by dividing the number of square miles in the country by the number of people. The greater the population density per square mile, the more crowded the country.

2. *Per-capita GDP* is the value of all the final goods and services produced in a year, divided by the population. The higher the per-capita GDP, the richer the nation. People in nations with high per-capita GDPs have a higher standard of living than people in nations with low per-capita GDPs.

3. *Births per 1000* is the number of babies born each year compared to the population. Population growth depends on this birth rate compared to the death rate. Only the birth rate is used in this lesson (to simplify the analysis).

4. *Female life expectancy* is a health indicator. The longer the life expectancy, the healthier the people of the country. A long life expectancy also usually means a lower death rate. We have used female life expectancy to simplify the analysis. Female life expectancy is usually one or two years longer than male life expectancy.

5. *Infant mortality per 1000 live births* is another health measure. It is the number of live babies that live for a year compared to the number of live babies born. Nations with low infant mortality rates have higher health standards and a higher standard of living than nations with high infant mortality rates.

F. Divide students into groups of three and direct them to answer the questions in Part 1. They probably will need help getting started.

G. Discuss the answers to the questions in Part 1. They are as follows:

1. U.S., Switzerland, Hong Kong, Canada, and Japan
2. 3103 people per square mile

3. 12.4 per 1000 people
4. 6.42 per 1000 live births
5. 81.6 years
6. Afghanistan, Bangladesh, Ethiopia, Somalia, and Uganda
7. 509.6 people per square mile
8. 44.4 per 1000 people
9. 119.2 per 1000 live births
10. 51.6 years

H. Now tell the students to return to their groups and answer the questions in Part 2. Assign each group to report to the class, and then have the class discuss each question. The answers are as follows:

1. Poor nations have higher birth rates. In poor nations, the benefits of having children are greater, while the opportunity costs of raising children are lower.

2. Birth rates decline as nations grow wealthier. Strong economic growth provides opportunities for individuals to obtain better paying jobs. Taking time to bear and rear children is a greater opportunity cost in this situation. One would expect that women would tend to have fewer children in this situation. It has been the pattern in developing countries with strong economic growth patterns.

3. Poor nations. There appears to be a lot of land left for future population expansion. Although richer nations have high population densities, they also have the wealth to fund programs that improve the environment. Again, one of the best programs to improve the environment is high economic growth.

4. It is much better in rich countries. Rich countries have lower infant mortality rates and longer life expectancies.

5. Its market economy has provided incentives for economic growth. Students may need some hints to answer this question.

CLOSURE

Display Visual 19, and discuss the answer to the mystery. People consider costs and benefits when they make choices. As economies grow, the opportunity costs of having more children increase and the monetary benefits decrease. Therefore, economic growth may be the most effective population control measure. To help students solve this mystery, remind them of the discussion at the beginning of the lesson.

ASSESSMENT

Multiple Choice

1. Which of the following statements is true?
   *a. People in rich nations have fewer children than people in poor nations.
   b. Nations with many people per square mile are usually poor.
   c. Because it has fewer people per square mile, China is richer than Hong Kong.
   d. People live longer in poor countries because the environment is much cleaner than in industrialized rich countries.

2. Which of the following occurs when nations become richer?
   a. The environment becomes dirtier.
   *b. The birth rate falls.
   c. Life expectancy decreases.
   d. The possibility of starvation increases.

Essay

Why are birth rates higher in poor countries than in rich countries?
(The key to this question is that people choose for good reasons. As economies grow, the opportunity costs of having more children increase, and the monetary benefits decrease. Because of these changing costs and benefits, families will tend to have fewer children as economies grow.)

Journal

Ask an adult friend who has children what were the costs and benefits they experienced when raising their children. Did they consider the opportunity costs when they chose to have children? Are their answers consistent with the conclusions reached in this lesson?

VISUAL 19
ECOMYSTERY: THE POPULATION MYSTERY

Why do people in poor nations generally have more children than people in rich nations?

From *Economics and the Environment: EcoDetectives*. © National Council on Economic Education, New York, NY

ACTIVITY 9
A TALE OF 20 NATIONS

Name_____

Directions: Carefully examine the statistics in the table below. Respond to the questions in Parts 1 and 2, on the next page.

Nation	Population density per square mile	Per-capita GDP (in $)	Births per 1000	Life expectancy—female	Infant mortality per 1000 live births
Afghanistan	63	220	44	43	164
Bangladesh	2,132	200	36	54	112
Belgium	848	17,300	10	80	8
Canada	7	1,944	14	81	7.3
China	315	360	22	72	33
Congo	17	1,070	43	56	110
Ethiopia	117	130	45	53	113
France	259	18,300	13	82	7
Germany	583	14,600	11	79	7
Haiti	607	440	43	55	104
Hong Kong*	14,180	21,500	12	83	5.8
Japan	830	19,100	10	82	4
Mexico	121	3,200	29	76	29
Singapore	12,464	13,900	18	78	6
Somalia	29	170	46	56	116
Switzerland	428	21,700	12	83	5
Taiwan	1,503	8,790	16	78	6
Uganda	207	300	51	52	91
U.K.	613	15,900	14	79	8
U.S.	70	22,470	14	79	10

*Hong Kong was a British Crown Colony until 1997 when it became part of the nation of China.
Source: *World Almanac, 1994*; for Hong Kong, the *CIA World FactBook, 1994*.

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ACTIVITY 9 (continued)

Part 1: Analyzing Statistics

1. Which five nations have the highest per- capita GDP? (We will consider these nations rich.)

2. What is the average population density per square mile of these five rich nations? (Hint: Add up these five nations' population density per square mile and divide by five.)

3. What is the average birth rate per 1000 people for these five rich nations? (Hint: Add up these five nations' births per 1000 and divide by five.)

4. What is the average infant mortality rate per 1000 live births for these five rich nations? (Hint: Add up these five nations' infant mortality rates and divide by five.)

5. What is the average female life expectancy for these five rich nations? (You shouldn't need a hint by now.)

6. Which five nations have the lowest per- capita GDP? (We will consider these nations poor.)

7. What is the average population density per square mile of these five poor nations?

8. What is the average birth rate per 1000 people for these five poor nations?

9. What is the average infant mortality rate per 1000 live births for these five poor nations?

10. What is the average female life expectancy for these five poor nations?

Part 2. Drawing Conclusions

1. Do rich nations or poor nations have a higher average birth rate? Why do you think this is so?

2. What will probably happen to population growth as nations become richer?

3. Do rich nations or poor nations have a higher average population density per square mile? What does this indicate about the capacity of the world's resources to support more people?

4. How does the quality of life in poor nations compare to the quality of life in rich nations? (Use statistics from the table to support your answer.)

5. Why does Hong Kong, which has the world's highest population density per square mile, have such a high standard of living compared to China, which has a much lower population density per square mile? (Hong Kong's per-capita GDP is 60 times higher than China's, and Hong Kong's population density is 45 times higher than China's.)

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LESSON NINE
WHY ARE THERE SO FEW WHALES AND SO MANY CHICKENS?

BACKGROUND

In the world today, chickens are plentiful, but many people worry about the whale population. Many students are involved in "save the whales" campaigns. Their activities might include adopting a whale, participating in whale watches, or buying merchandise to support "save the whales" organizations. However, few students participate in campaigns to save pigs, cows, or chickens, even though those animals are slaughtered in large numbers every day.

ECOMYSTERY

Why do we have so few whales and so many chickens?

ECONOMIC REASONING

In order to solve this mystery, students need to know about "the tragedy of the commons." In eighteenth century England, towns reserved some land as common land that would be available for everyone to use without charge. (This policy was adopted by some colonial cities in the eastern United States; the Boston Common is a well-known example.) Because everyone could use the common land without charge, shepherds in England used common land rather than their own land for grazing. There was no problem at first, as long as only a few people used the commons; but when many did, they overgrazed the land. The grass died.

The key to understanding "the tragedy of the commons" is to remember that *people are more likely to take better care of things they own and value*. Private ownership creates rewards that encourage wise use of property and conservation of resources for use in the future. The wise use of property increases its future value.

Publicly owned land creates incentives for overuse. When everyone owns land collectively, people who actually use the land share the costs of their use with everybody else—including those who don't use it. For example, people in England placed additional animals on the common land even though the livestock were scrawny and unhealthy and the common overgrazed.

Pigs, cows, and chickens are privately owned. If farmers killed all their livestock, they would not have any pigs, cows, and chickens to sell in the future. But whales roaming the oceans have no owners. Whalers have no reason not to kill whales *now*, before other people do; to hold back now is to risk losing the opportunity to harvest and sell a whale that somebody else will kill if a whaler doesn't. In effect, whales are like the common land—anyone who wants to do so can use them.

ECONOMIC CONCEPTS

Benefits
Incentives
Opportunity Cost
Scarcity

OBJECTIVES

1. Students use economic reasoning to explain why whales are an endangered species while pigs, cows, and chickens are plentiful.

2. Students explain why people generally take better care of things they own and value.

3. Students explain how private ownership provides incentives to manage resources wisely.

TIME

One class period

MATERIALS

- Visuals 20 and 21
- Paper clips
- Colored paper squares (one quarter of an 8.5 x 11 inch sheet of paper, two squares per student)
- Bag of small candies

PROCEDURE

A. Explain that the purpose of this lesson is to learn why some resources are overused while

others are protected and preserved. The lesson helps demonstrate the idea that people generally take better care of things they own and value.

B. To begin the demonstration, throw several paper clips on the floor.

C. Tell students that, after you say "Go," you will give them a piece of candy for every paper clip they give you. (Even though the simulation works best if you have no rules, you may want to tell them that they cannot dive for the paper clips or push and shove too much. We do not want any endangered students.)

D. Say "Go," telling the students that they are free to pick up the paper clips and trade them for candy. Students will probably rush to grab the paper clips and to trade all the clips they retrieve for candy.

E. Ask students why they didn't leave some of the paper clips on the floor or save some for later. (They will probably say that if they didn't grab them other students would.)

F. Now give each student two squares of colored paper. They can trade these for candy. But for each day they *keep* the two paper squares, they will receive *another* square, and each square is worth a piece of candy.

G. Ask students how many of them want to trade their paper squares for candy. (Probably some will trade immediately, but others will want to get more candy later.)

H. Ask students why they made the decision to trade their paper squares now or later. Accept a variety of answers.

I. Explain that the paper clips are like whales and the paper squares are like chickens. Display Visual 20. Ask students to reflect on their experience in the simulation to solve the mystery.

J. If students have trouble solving the mystery, explain that the chickens are privately owned while whales just roam the oceans. Assigning and enforcing property rights creates incentives to conserve resources. This is because the owner has strong incentives to maintain and improve the resource for use in the future. Commonly owned property may be overused and not conserved. Whalers felt that if they did not kill a whale, someone else would. The whales became victims of economic incentives.

K. Display Visual 21. Prompt students to discuss the answers.

1. Most students would take better care of their own property than the school's property. In the discussion, you may want to refer to litter and other damage to your school's property.

2. The key to question 2 is that students own their property and have an incentive to take good care of it.

3. Question 3 is more difficult. Whales in the ocean cannot be restricted to one location, so it is difficult to establish ownership rights. John Majewski of the University of Texas has proposed attaching transmitting devices to whales. He thinks this would not be hard to do. These devices would give whales radio signal "brands." Ownership rights to whales could then be purchased by whalers who would want their private whale population to be protected and to grow. Under this system, existing laws that now protect property rights on the seas would also protect whales. "Whale rustlers" would become pirates who could be arrested and fined.

CLOSURE

Ask students to identify something they own in which they have much pride. Why is this?

ASSESSMENT

Multiple Choice

1. Which of the following programs would be most effective in conserving whales and fish for future generations?
   a. The government should own or control all waterways.

b. People should be free to fish as often as they like so they get tired of it.
*c. Allow people to own certain lakes and waterways.
d. Set up government rules to prevent people from fishing on most waterways and oceans.

2. Which of the following programs would best preserve public lands for future generations?
*a. Allow environmentalists the right to lease or buy the land in order to conserve it.
b. Pass a law that prevents farmers from renting the land for more than a year.
c. Rent the land at a low price so farmers can afford to fix it up.
d. Require farmers to sell any privately owned land to the government if they are not farming it.

Essay

Which of these actions would be most effective in preventing elephants from becoming extinct? Explain your conclusion.

a. Pass a law that bans the sale of ivory and makes it a crime to shoot elephants for any reason.
b. Create privately owned game preserves that charge people to view elephants in their natural environment.

(Choice **a.** looks good at first glance, but this policy may have harmful unintended consequences. The ban on ivory decreases the ivory supply and therefore raises the price of ivory. This creates a powerful incentive to kill elephants in order to receive the benefits of large illegal profits. Poachers will kill elephants in order to sell ivory for high prices on black markets. Choice **b.** better follows the principles of ecodetection. It creates incentives to preserve the elephants. By keeping the elephants alive, profits can be made. However, the local people must share in these game-preserve profits if they are to see them as incentives not to poach.)

Journal

Ask an adult what improvements they made over the past few years in their house or apartment. Why did they make these improvements? Did renting or owning make a difference as they made their decisions? Record their answers in your journal.

VISUAL 20

ECOMYSTERY: THE CASE OF THE MISSING WHALES AND THE ABUNDANT CHICKENS

Why do we have so few whales and so many chickens?

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

VISUAL 21
WHAT WOULD YOU DO?

1. Do you take better care of your school's property or your own property? Why?

2. Have you ever fixed up or improved something you owned? Why were you willing to do this?

3. What are some ideas for how we could create private ownership for whales to help prevent them from becoming extinct?

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LESSON TEN
WHY DO NONRENEWABLE RESOURCES KEEP INCREASING?

BACKGROUND

The physical amount of petroleum in the world is fixed. It was created by changes that took place in the environment millions of years ago. Every day we pump millions of barrels to be refined and sold worldwide so that people can drive cars, use electricity, fertilize their food, and wear wrinkle-proof clothing.

Many environmentalists are concerned about the use of fossil fuels. Using fossil fuels pollutes the land and air; it may also make us dependent on an unreliable, unsustainable future source of energy. The underlying question is whether we are in danger of running out of fossil fuels. In 1978 this concern was raised by the U.S. federal government when proven oil reserves were 648 billion barrels—enough to last for 29 years, given then-current rates of consumption. In the following 14 years, nearly 84 billion barrels have been extracted and burned, yet proven reserves of oil have actually increased by 351 billion barrels. Today there is enough oil in proven resources to last for 45 years—not the 15 years one might have guessed, based on 1978 information.

ECOMYSTERY

How can the amount of oil (a nonrenewable resource) increase when greater amounts are burned every day?

ECONOMIC REASONING

The core misunderstandings here are two: first, that we know how much oil is available under the earth's crust; and second, that the *physical* supply and the *economic* supply of oil are the same thing.

Oil supplies are measured as *provable reserves* at current prices and technology levels. As prices rise or costs of extraction fall, suppliers are given greater incentives to find more oil. Rising prices also encourage suppliers to extract oil that was previously known to exist but was considered too difficult to obtain. These price incentives have also encouraged suppliers to find more oil and list it as provable reserves. We have no idea what the physical amount of petroleum concealed by the earth's crust might be. We do know something about the physical amount of petroleum that people now have an incentive to find. This last amount can change as incentives change.

ECONOMIC CONCEPTS

Supply
Price

OBJECTIVES

1. Students define the concept of *provable reserves* of petroleum.

2. After participating in a demonstration, students generalize about the effect of incentives on the amount of petroleum available to the public.

3. Students explain how a nonrenewable resource such as petroleum can increase in availability while huge amounts of it are being consumed.

TIME

One class period

MATERIALS

- For each small group, a large (two-quart) plastic bowl with a cover
- Several large sponges to place in the bowls
- Several bottles of dark-colored water. (Add small amounts of pepper or salt so that students will not want to drink the water.)
- Drinking straws
- Measuring cups
- Measuring spoons
- Visuals 22, 23, 24, and 25
- Activity 10

PROCEDURE

A. Explain that today students will attempt to discover oil. Many people are concerned that the world will run out of oil before very long. In this lesson, students will do some estimat-

ing in a class experiment and compare their findings to their predictions.

B. Display Visual 22. Invite students to speculate on how the amount of oil (a nonrenewable resource) can increase when huge amounts are burned every day. Discuss answers.

C. Display Visual 23. Ask students to interpret what the graph shows about the amount of available oil. Ask:

1. What happened to the amount of oil reserves from 1948 to 1990?
(Reserves increased from approximately 40 billion barrels to over 1 trillion barrels.)

2. Did people stop using oil to drive cars, produce electricity, grow food, and make clothing from 1948 to 1990?
(No. They continued to use oil at an increasing rate.)

3. How can the number of barrels of oil reserves continue to increase when people are burning oil regularly in their work and play?
(Accept a variety of responses here. It will be explained later in the lesson.)

D. To explain this apparent contradiction, ask the students to work in group(s) to estimate how much dark liquid there is in a plastic bowl. (This experiment can be conducted in two different ways, depending on how much students are involved.)

1. **Demonstration Method** Conduct a demonstration in which three to five students participate in the experiment directly and the remaining students observe. This procedure reduces management tasks.

2. **Small Group Method** Divide the class into small groups to carry out the demonstration and compare their results. This procedure involves more students directly in the experiment, but it also requires more attention to management on the part of the teacher.

E. Directions for both methods:

1. It is important to prepare the covered plastic bowls carefully. Oil is found in porous rock that contains the petroleum much as a sponge holds fluid. For this reason, place dry sponges in the bowl. Then pour fluid into the bowl and let the sponges soak up most of it. Be sure to use a cup measure to pour the fluid into the bowl. It is important that you know how much fluid you put into the bowls. After the sponges are full, pour in some more fluid so the students can hear it move around (but do not fill the bowl to the top).

2. Drill three small holes in the cover of the bowl, holes large enough to allow you to insert a drinking straw. Place the cover on the bowl. Explain that students are not to remove the cover unless you tell them to.

3. Give students a measuring cup so they can estimate how many cups of fluid are in the bowl.

4. Distribute Activity 10. Show students how to make a graph that represents cups on the vertical axis and rounds on the horizontal axis. Say, for example, that you estimate there are three cups of fluid in the bowl. Place three Xs above Round 1 to show this.

F1. **Demonstration Method** Choose three students to estimate how much fluid exists in a sealed plastic bowl. Move the classroom desks so the group is in the center of the room, surrounded by the observing students. Follow the remaining procedures as described.

F2. **Small Group Method** Divide students into small groups. Explain that they will attempt to estimate the total amount of fluid in the bowl and graph their estimates for presentation to the rest of the group. There will be four rounds, so they will have time to perfect their estimate.

G. Round 1: Students cannot pick up the bowl or look inside. They may only move it around or attempt to draw out samples with the straws. They cannot press down with the straws.

When they encounter an obstacle (the sponge), they must put no more pressure on the straw. Ask students to guess how many cups of fluid they could extract with their straws under these conditions and place that estimate on their graph in Activity 10.

H. Round 2: Tell students to press down with their straws as they attempt to extract samples. It is okay to press hard with two straws while attempting to sample with the third straw. Have them make another estimate and put their new estimates on the graph.

I. Round 3: Students can look inside the cover by opening the flap. They cannot take the cover off the bowl. They can use their measuring spoon to press down on the sponges inside, as a means of improving their sampling. Have them make another estimate and put their new estimates on the graph.

J. Round 4: Allow students to open the lid and investigate with their measuring spoons and straws. Have them make a new estimate and put this final estimate on the graph.

K. Have students compare their estimates by displaying their results on the bulletin board. Ask each group to explain its estimates; discuss why the estimates differ.

L. Tell students how much fluid was in each bowl. Ask them why it was difficult to make a correct estimate.
(Lack of information, inadequate tools, and lack of technology.)

M. Explain how this experiment relates to finding oil. Geologists have the same problem with oil exploration. They must estimate oil reserves from samples. Their estimates become more accurate when they can use seismic sounding or send probes with cameras beneath the earth's surface. As the search technology improves, the estimates of availability also grow.

N. What would happen to the estimates if students knew they would get $10 per cup for the fluid and also knew that more plastic bowls such as these were located all over the school?
(Students would search for more bowls; as they found them, the estimates of reserves would grow.)

O. What happens as the price of oil increases or the costs of searching go down?
(Expectations would be that estimates of oil reserves would increase.)

P. Display Visual 24. Does it tell students how much oil remains in the earth's crust?
(No. Provable reserves include only amounts that already have been discovered and are recoverable with present technology at current prices. Provable reserves will change as prices move up or down and as new technology is invented to improve oil extraction.)

Q. Display Visual 22 again and review the mystery. Display Visual 25 and review the ecodetection principles. Ask students to explain how the amount of oil (a nonrenewable resource) can increase when huge amounts of it are burned every day.
(Oil companies' choices are influenced by rewards. As they explore for oil, they know that the estimates tell only what can be recovered today. As prices and technology change, these reserve estimates increase or decrease. These reserve estimates do not reveal how much oil remains in the earth's crust. No one knows how much oil still remains, but the amount is much greater than the reserve estimates indicate.)

CLOSURE

Summarize the key points suggested by the demonstration. Estimates of reserves are not accurate estimates of the physical amount of fossil fuel in the earth's crust. People's choices are influenced by rewards. Estimates of fossil fuel reserves change with changing prices and technology.

ASSESSMENT

Multiple Choice

1. Which of the following statements is false?
   a. Petroleum is a fossil fuel.
   b. Provable reserves of petroleum have increased from 1948 to 1995.

c. People around the world are using more petroleum.
*d. The available amount of petroleum is decreasing.

2. Which of the following answers is an example of an incentive to produce oil?
a. Consumers decide to use less oil.
b. Businesses decide to use less oil.
c. Governments decide to use less oil.
*d. Higher prices are paid for oil.

Essay

1. Read the following statement. Tell whether you think it is an accurate statement. Explain your answer.

"Oil is a nonrenewable resource. In 10 years we will not have any oil left to use for gas in our automobiles."

(Petroleum is a nonrenewable resource as we presently produce it. It comes from fossil remains in the earth's crust. But we have several decades of provable reserves remaining. Provable resources have increased since 1948 and they are likely to increase more. Also, we have not found all the reserves that exist in the earth's crust.)

2. Read the following statement. Write a reply, using the concepts of *provable reserves* and *incentives* to help the writer understand this problem better.

"I can't believe statistics these days. Provable reserves of petroleum are greater now than 1948. But petroleum is limited. We have been using it heavily since 1948. How can it keep increasing when we use so much of it?"

(The writer doesn't understand what "provable reserves" means. "Provable reserves" refers to the amount of petroleum available at today's prices and technology. Provable reserves can increase if incentives such as higher prices or lower costs encourage producers to find and extract more petroleum. The numbers are not influenced by how much petroleum we have already used.)

Journal

Students survey 10 different people, asking them if they think the world is running out of petroleum. They compare their answers to what they have learned about provable reserves of petroleum.

VISUAL 22

ECOMYSTERY: THE CASE OF THE NONRENEWABLE RESOURCE

How can the amount of oil (a nonrenewable resource) increase when huge amounts of it are burned every day?

From *Economics and the Environment: EcoDetectives*. © National Council on Economic Education, New York, NY

VISUAL 23
WILL WE RUN OUT OF PETROLEUM?

Growth in Global Oil Reserves

Source: American Petroleum Institute, 1994.

From *Economics and the Environment: EcoDetectives*. © National Council on Economic Education, New York, NY

VISUAL 24
DEFINITION OF *PROVABLE RESERVES*

Provable reserves of fossil fuels such as coal, gas, and oil include only those amounts that have already been discovered and can be recovered with present technology at current prices.

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

VISUAL 25
THE PRINCIPLES OF ECODETECTION

1. People's *choices* influence the environment.

2. People's choices have *unintended results*.

3. People's choices are influenced by *rewards*.

4. People are more likely to take better care of things they *own and value*.

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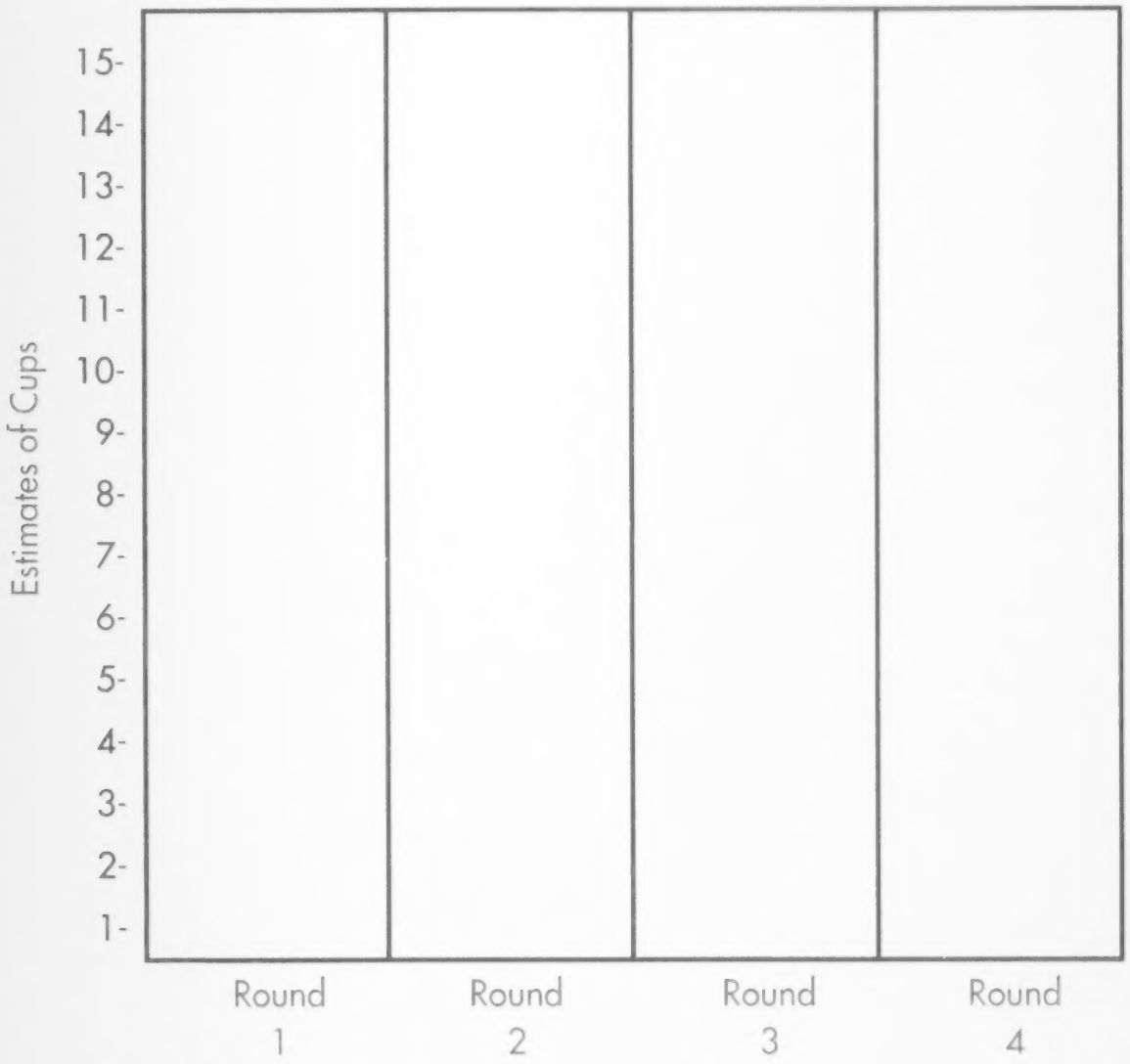
ACTIVITY 10
ESTIMATING RESERVES GRAPH

Name_____

Directions: After each round of this demonstration, estimate how many cups of fluid are in the plastic bowl. Place Xs in the appropriate column to indicate your estimate for each round.



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LESSON ELEVEN
CAN INSECTICIDES HELP US FIGHT CANCER?

BACKGROUND

Insecticides are widely regarded as harmful. Indeed, some insecticides have contributed to harming ground water and wildlife. Some people claim that insecticides used to increase food production have also contributed to increased rates of cancer. Yet many mainstream scientists believe that pesticides contribute little to increased cancer risks, and some contend that the use of pesticides has actually decreased some cancer risks.

ECOMYSTERY

How could insecticides—materials associated with causing harm to the environment—act as important weapons in the fight against cancer?

ECONOMIC REASONING

Pesticides enable farmers to increase their production of fresh fruits and vegetables, at lower costs. The increased supply of fresh fruits and vegetables usually means lower prices for these goods in the grocery stores. When prices are lower, consumers buy more. As consumers enrich their diet by eating more fresh fruits and vegetables, they decrease their risk of getting cancer. The benefit of an improved diet may outweigh any risk introduced by the use of pesticides.

ECONOMIC CONCEPTS

Costs
Benefits
Risk

OBJECTIVES

1. Students recognize that all choices involve costs and benefits.

2. Students explain how the use of insecticides to reduce the price of fruit and vegetables can contribute to reducing the incidence of cancer.

TIME REQUIRED

1 class period

MATERIALS

- A coin
- Visuals 26 and 27
- Activity 11

PROCEDURE

A. Explain that the purpose of this lesson is to analyze the risks involved in the choices people make. Today, the focus is on choices people make regarding the use of insecticides.

B. Explain that people's lives cannot be risk-free. There is no activity people engage in or product people use that is free of risk. Display Visual 26. Invite students to discuss activities they engage in regularly and to explain whether they judge the risks to be worth the benefits. List their ideas on Visual 26.

C. Pose another risk situation to the class. Is it worth it to gamble on coin flips? Imagine that I want to bet you $1 that a coin flip will come up heads. Ask:

   1. How many of you would be willing to bet with me?
      (Probably a few students will volunteer.)

   2. What is the risk of this bet?
      (The odds are 1 in 2 that you will win.)

   3. Is this a risk worth taking?
      (High-risk takers will say yes, low-risk takers will say no.)

D. Pose yet another risk problem to the class. Explain that one large urban school district runs 6,000 daily bus routes to take students to and from school every day. There are on average four school bus accidents per day, and these are usually very minor. Ask:

   1. How many of you would be willing to ride on the bus to school if you went to school in this district?
      (Probably the majority of the class.)

2. What is the risk of bus riding?
(The odds of a safe ride are 1500 to 1.)

3. Is this a risk worth taking?
(Even low-risk takers will probably say yes.)

E. Explain that there are no risk- free choices. Moreover, the actions we take to reduce some risks create *other* risks. For example, surgery for heart disease may decrease a patient's chance of suffering a heart attack, but it also increases the patient's risk of death or injury from the surgery itself. Inoculations to prevent influenza may prevent the spread of a serious infection, but for some people the inoculation itself carries risk.

F. Explain that mainstream scientists have argued that the health risks associated with the use of insecticides have been vastly overstated. While all decisions involve risks, the chances of getting cancer from insecticides used in the United States are more like the chances you take in riding a bus to school than the chance you take in betting on a coin toss. In fact, some highly respected scientists believe that insecticides are a tool to fight cancer. Display Visual 27 and invite students to speculate on the explanation of this mystery.

G. Distribute Activity 11. Assign students to the roles of Radio D.J., Dr. Betty B. Roccoli, Tiffany from Tallahassee, Sam from Seattle, Dominic from Dallas, Minnie from Minneapolis, and Newt from New Mexico. Ask them to read the script as other students listen.

H. When students have completed the script, ask:

1. Why do cancer risks increase with age?
(Cancer is related to age. In burning up fat and carbohydrates, we produce oxidants and these oxidants increase the chance of getting cancer.)

2. How can diet reduce cancer risk?
(A diet rich in fruit and vegetables can help to reduce cancer risk.)

3. What is the effect of insecticides on food production?
(Insecticides enable farmers to produce more fruits and vegetables at low costs.)

4. How can insecticides reduce cancer risks?
(As the supply of fresh fruits and vegetables increases, the price consumers pay for fresh fruits and vegetables decreases. Lower prices encourage consumers to eat more fresh fruits and vegetables—thus reducing their chance of getting cancer.)

5. What are the risks in using insecticides and other chemicals in agriculture?
(Fertilizers can spill into waterways, encouraging the growth of algae that can hurt plants and fish. Chemicals can make their way into ground water. Chemicals, when used carelessly and in excessive amounts, can cause harm to wildlife.)

6. Do you think that risks of insecticide use are worth the benefits?
(While student responses may vary, encourage them to consider the benefits of diet improvement relative to the current risks associated with pesticide use.)

CLOSURE

Review the main points of the lesson. Ask:

In what ways are we all risk takers?
(Everyday decisions such as riding on the bus to school involve some degree of risk. All choices involve risk.)

Which activity do you think presents the greatest risk of causing cancer: smoking or eating an apple every day which has been treated with the chemical Alar?
(Smoking is clearly linked to increasing cancer risk. Alar is a chemical presenting a very low cancer risk. A diet rich in apples is one step toward a diet that reduces overall cancer risks.)

ASSESSMENT

Multiple Choice

1. All choices involve
*a. risk
b. school

c. time
d. parents

2. Insecticides may reduce cancer risks because they
a. help keep vegetable prices high.
*b. help keep vegetable prices low.
c. reduce the amount of oxidants in our bodies.
d. are provided free by the government.

Essay

All decisions people make involve risks. How can individuals weigh the risks of using insecticides as they relate to cancer?
(A diet rich in fruits and vegetables helps reduce the risk of getting cancer. How can people be encouraged to eat more fruits and vegetables? One way is to keep the price low by keeping food supplies high. Insecticides enable farmers to produce more fruits and vegetables at low costs. Lower costs for the farmers usually mean lower prices for consumers. And when prices are lower, consumers buy more. The benefits of an improved diet must be weighed against the risks that might be associated with pesticides.)

Journal

Visit a grocery store. Conduct a short interview with the store manager, inquiring about the supply of fruits and vegetables. Why do prices go up? Why do they go down? When are various kinds of fruits and vegetables available? Do people seem to be eating more fresh fruits and vegetables or less, compared to past years? Do people of different age groups differ in the amounts of fruits and vegetables they buy?

VISUAL 26
ARE YOU A RISK TAKER?

ACTIVITY	RISKS	IS THE RISK WORTH IT?
1. In-line skating	Scrapes Bruises Broken bones	
2. Bicycle riding		
3. Doing dishes		
4.		
5.		
6.		
7.		
8.		

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VISUAL 27

ECOMYSTERY: INSECTICIDES AND CANCER

How could insecticides—materials associated with causing harm to the environment—act as important weapons in the fight against cancer?

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ACTIVITY 11
THE DOC-OF-THE-DAY CALL-IN SHOW

Name_____

Radio DJ
Hello health fans! Welcome to the nation's newest health-care show, Doc of the Day. This is the radio call-in show that lets you, the listener, get the latest health information. Today our topic is how to reduce the risks of cancer. Our guest is Dr. Betty B. Roccoli. Hello Dr. Roccoli. Welcome to our show.

Dr. Roccoli
Hello DJ, and hello to all those people who tuned in today. I am ready to take your questions.

Radio DJ
Here is our first caller: Tiffany from Tallahassee. You're on the air, Tiffany.

Tiffany from Tallahassee
Hello, Dr. Roccoli. My grandfather had cancer, but I never understood why. It was scary. Can you explain to me why so many people get cancer?

Dr. Roccoli
We all know someone who has been ill from cancer. Cancer is a disease that we would all like to avoid. Cancer is most closely related to age. The older we get, the more likely we are to get cancer in some form. Why? In burning up our fuel—fat and carbohydrates—we produce oxidants, and these oxidants increase the chance of getting cancer. Short of premature death, there is no way to stop this process.

Radio DJ
Wow! That sounds pretty gloomy. Isn't there some way to reduce the effects of oxidants?

Dr. Roccoli
Yes, the effects of oxidants on the body can be reduced. Nutrients such as vitamin C and vitamin E and carotenoids in fruits and vegetables are among the weapons our bodies use to defend against cancer. A diet rich in fruit and vegetables helps to reduce cancer risk.

Sam from Seattle
I know that farmers use lots of insecticides in producing food. Why do they do that?

Dr. Roccoli
Farmers use insecticides to increase the quantity and quality of the food they produce. Insecticides help to keep the price of food low. Efforts to eliminate current insecticides would cause a sharp reduction in food supplies, and this would increase the price we'd pay for food in the grocery store.

Dominic from Dallas
Do you mean that using insecticides can help reduce cancer risks?

Dr. Roccoli
Yes I do. Here is how. Insecticides enable farmers to produce more fruits and vegetables at lower cost. The increase in food produced helps to reduce food prices for consumers. These low prices encourage people to eat healthier. There is evidence that eating healthful food is a way to reduce the chance of getting cancer. On the other hand, the dangers from insecticides are very low. Highly regarded scientists such as Dr. Bruce N. Ames, University of California at Berkeley, and C. Everett Koop, former Surgeon General of the United States, state clearly that pesticides contribute very little to any cancer risks.

Minnie from Minneapolis
I thought that insecticides hurt the environment. What are the risks of using insecticides?

Dr. Roccoli
All choices involve risks. Insecticides can hurt humans and wildlife. They need to be used carefully. Fertilizers provide nutrients to crops, but fertilizers also can spill into waterways where they encourage the growth of algae that can hurt plants and fish. Chemicals can make their way into groundwater. Chemicals, when used carelessly and

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ACTIVITY 11 (continued)

in excessive amounts, can cause harm to wildlife. Farm workers run a higher risk of harm from pesticides than people in other occupations do.

Newt from New Mexico
Okay, now I understand that the use of insecticides involves costs and benefits. But do you think the benefits of using insecticides in farming outweigh the risks involved?

Dr. Roccoli
For many in the scientific community, this is a simple question. The benefits easily outweigh the risks. Pesticides on foods do not pose a serious health threat. The possibility that pesticides contribute to cancer is very low. However, the benefits of eating fruit and vegetables are very high. Careless, excessive use of pesticides has been significantly reduced. Moreover, pesticides have been improved. Newer pesticides do not remain long in the environment, and they harm wildlife less than the older ones did.

Radio DJ
Well, Doc, that is all the time we have for today. Thank you for being with us today.

Dr. Roccoli
You're welcome.

Radio DJ
Be sure to join us tomorrow when we will ask Dr. Odie Payne about how to set up an effective exercise program. She will be followed by Misty Plane, our regular travel consultant, who will tell us about healthy getaways. Please tune in. We will be listening.

LESSON TWELVE
WHY DRIVE WHEN YOU CAN RIDE?

BACKGROUND

Americans have never had more automobiles than they have today. And automobiles cause problems. They contribute to air pollution. They contribute to congestion. They contribute to noise pollution. To reduce this air and noise pollution and reduce congestion on the freeways, people are encouraged to use mass transportation. But many people seem reluctant to do so, even when mass transit is readily available. To deal with this problem, the U.S. government is considering large-scale efforts to require employers to reduce the use of cars by their employees.

ECOMYSTERY

Why do some people—people who are environmentally aware, recycle their garbage, and never litter—refuse to use mass transit? Why do they prefer to drive on crowded freeways, wait in long lines at meters, and contribute to the pollution of the air we breathe?

ECONOMIC REASONING

In deciding to drive rather than use mass transit, Americans are influenced by incentives. The state and federal governments help to keep the cost of driving low. They do this by providing freeways paid for by all the taxpayers. Taxpayers who use the freeways the most—those who drive cars and trucks frequently—don't pay much in direct, additional fees, even though their heavy use of the roads imposes costs on others. Because their use of the roads is subsidized, drivers have an incentive to overuse their vehicles, causing pollution that they don't have to pay for. Market solutions to this problem would require drivers to pay more fully for the actual cost of their driving.

ECONOMIC CONCEPTS

Cost
Benefit

OBJECTIVE

Students use a cost-benefit analysis to assess ways of reducing air pollution.

TIME

One class period

MATERIALS

- Visuals 28-34

PROCEDURE

A. Explain that the purpose of this lesson is to show how to use costs and benefits to encourage voluntary efforts to reduce air pollution from automobiles.

B. Display Visual 28. After the class has read the example, ask: What do each of these situations have in common?
(In each case, a service was provided at no charge, and people tended to overuse the service.)

C. Explain that driving cars on freeways is somewhat like going to concerts without having to buy an admission ticket. While drivers do pay some of the costs for using highways—by the gasoline taxes they pay—they do not pay all the costs. Display Visual 29. Invite the students to speculate on possible explanations.

D. Display Visual 30. Explain that only a minority of people—even those people living in congested areas of the country—choose to use mass transit. Instead, they drive their cars to work.

E. Display **The Principles of EcoDetection**. Invite students to use the principles of ecodetection to solve the mystery of why people drive their cars to work rather than choose mass transit.

F. Ask: What are the benefits or rewards people gain by driving their cars to work rather than taking mass transit or car pooling? After students have suggested reasons, display Visual 31 and compare their responses to those listed.

G. Ask: What are the costs of driving to work for the individual drivers? After students have suggested reasons, display Visual 32 and compare their responses to those listed.

H. Ask: What are the costs individual drivers impose on others? After students have suggested reasons, display Visual 33 and compare their responses to those listed.

I. Explain that it seems clear that drivers—even nice people who generally wish to protect the environment—know that the benefits to them for driving are relatively high and the individual costs to them are relatively low. The problem is that drivers are imposing unwanted costs on others. In other words, individual drivers are not fully paying for the benefits they are receiving.

J. Ask: What might we do to make sure that drivers will pay more directly for the benefits they are receiving? After students have suggested some alternatives, display Visual 34 and compare their responses to those listed.

K. What would be the likely effects of choosing one or more of the alternatives listed on Visual 34? After students have suggested some consequences, point out that people would be encouraged to car pool or use mass transit. Air and noise pollution would be reduced. Explain that the economist Michael Cameron found that charging drivers a nickel a mile would reduce both the miles driven and pollutants by 10%. Traffic delays would be reduced by 25%.

CLOSURE

Review the main points of the lesson. Ask:
Why is there congestion on freeways?
(People who use the freeways receive many benefits, but they do not pay their full share of the costs they impose on others in the form of increased air pollution.)

How might the use of tollways reduce air pollution?
(After students have suggested some consequences, point out that people would be encouraged to car pool or use mass transit. Air and noise pollution would be reduced.)

ASSESSMENT

Multiple Choice

1. Airlines are often accused of creating noise pollution and congestion during peak travel times—mornings and evenings. What would an ecodetective advise us to do to reduce noise and congestion caused by air travel?
   a. Pass a law requiring reduced noise and congestion.
   b. Study the problem.
   *c. Charge airline companies landing fees.
   d. Buy ear plugs for homeowners near airports.

2. Tollways, toll charges at exit ramps, and parking fees are devices requiring individual drivers to pay for the costs they impose on
   a. themselves.
   b. immigrants.
   *c. other drivers.
   d. their children.

Essays

What are some of the costs individuals pay when they drive on busy freeways? What are the costs for which individual drivers do not pay? Discuss these questions in a brief essay.
(Individuals usually pay for costs such as purchase and maintenance of the car, plus expenses related to fuel, car repair, and insurance. Costs imposed on others, which they do not pay for, include increased air pollution, noise, and making others late to work.)

Leon's mother usually drives on the expressway to work. Leon tells her that she should car pool with one of her friends. She tells Leon about getting Leon's brother to day care and trips she must make to the bank, grocery store, and video store. She gets angry whenever Leon brings car pooling up. Propose a solution that Leon might try to get his mother to reduce her driving voluntarily. Explain your proposed solution by reference to costs and benefits.
(Leon's mother derives benefits from using the freeways. These benefits cost her little, and they make it easy for her to run her errands. Leon's mother may be "overusing" the freeway. She might be encouraged to reduce her use of the freeways if she had to make an individual pay-

ment for her freeway use, by paying a toll, for example.)

Journal

Imagine that a tollway (an expressway where people pay 5 cents per mile) was built to run alongside an expressway (a road where no tolls are charged). Predict how drivers would or would not change their driving habits.

VISUAL 28
IT SURE GETS CROWDED SOMETIMES

Townsend, Wisconsin, is famous for its spectacular Fourth of July fireworks display. Local residents and tourists crowd into the city park to watch. Cars are parked everywhere—often illegally. People stand shoulder-to-shoulder or are huddled close together on blankets or lawn chairs.

To generate publicity for a new blockbuster movie, Disney sets up giant movie screens in New York's Central Park and invites everyone to watch its new film—no charge for admission. The areas around the screens are packed tight with movie fans.

The Roadkill Warrior Maniacs, a rock band wanting to earn its 15 minutes of fame, gave a concert in a farmer's cornfield. The band did not charge for the tickets. The band's fans arrived in droves. People were everywhere.

Question for Discussion:
What do these situations have in common?

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VISUAL 29
ECOMYSTERY: WHY WAIT IN LINE WHEN YOU CAN RIDE ON THE BUS AND HELP THE ENVIRONMENT?

Why do people—people who are environmentally aware, recycle their garbage, and never litter—refuse to use mass transit? Why do they prefer to drive on crowded freeways, wait in long lines at meters, and contribute to the pollution of the air we breath?

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VISUAL 30
HOW PEOPLE GOT TO WORK IN 1990

LOCATION	PERCENT OF PEOPLE USING MASS TRANSIT
Washington D.C.	36.6
New York City	24.8
Illinois	10.1
New Jersey	8.8
Massachusetts	8.3
Wisconsin	2.5

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VISUAL 31

WHAT ARE THE BENEFITS OF DRIVING TO WORK?

1. Allows people to leave and return to home when they wish to.

2. Makes running errands (daycare center, grocery store, bank, school) easier.

3. Saves time and trouble in planning schedules with others.

4. Reduces use of mass transit—which may be unreliable, uncomfortable, and may require long walks.

5. Reduces exposure to bad weather.

6. Provides a pleasant time to be alone—to listen to good music, plan the day, and so on.

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VISUAL 32

WHAT ARE THE COSTS OF DRIVING TO INDIVIDUAL CAR OWNERS?

1. Purchase and maintenance of the car including fuel, car repair, insurance, and so on.

2. Time spent in congested traffic that would otherwise be time spent at work or play.

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VISUAL 33

WHAT ARE THE COSTS INDIVIDUAL DRIVERS IMPOSE ON OTHERS?

1. Drivers contribute to air pollution.

2. Drivers increase noise levels in neighborhoods near freeways.

3. Drivers congest roads and slow down traffic.

4. Abandoned cars and car parts make cities and the countryside less attractive.

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VISUAL 34
ALTERNATIVES TO DRIVING "FREE"

1. Build tollways as alternatives to freeways. Charge a fee for each mile driven on the tollways.

2. Charge tolls on freeways during peak travel times.

3. Charge tolls on freeway exit and entrance ramps during peak travel times.

4. Increase fees for parking.

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LESSON THIRTEEN
WILL THERE BE FOOD FOR YOU?

BACKGROUND

Many people fear that Earth's population is about to surpass the planet's carrying capacity. Thomas Robert Malthus and Lester Brown are among those who have predicted worldwide starvation. Ecological collapse looms, according to this view. The only hope is to reduce runaway birthrates aggressively. But is it? Recent scientific studies confirm that Earth's basic resources are vastly greater than what will be needed to feed even the 10 billion people who are almost certain to inhabit the planet by 2050. The real threat is not that Earth will run out of top soil, land, or water, but that nations will fail to pursue the economic policies and research policies that are needed to increase the production of food.

ECOMYSTERY

When Earth's population grows, why don't people on Earth starve?

ECONOMIC REASONING

If the population grew and ways of producing food didn't change, people would starve. But market systems have been much more responsive to population changes than alarmists have predicted. The crucial factor is not the limits of natural resources in any one nation. A focus on resource limitations leads to a fundamental misunderstanding of the problem. Food production is better explained by reference to incentives. Private ownership of resources rewards people for being productive. In order to be productive, people seek technological development. Food production governed by these market forces has provided widespread food abundance. World markets are characterized by food surpluses, not shortages. Famines are rare and have little to do with food production or overpopulation. The average price for food in world markets has declined to historic lows. New technology promises continued increases in levels of food production.

ECONOMIC CONCEPTS

Rewards
Private property rights
Productivity

OBJECTIVE

Students analyze the effects of incentives on food production.

TIME

One class period

MATERIALS

- Classroom set of calculators
- Visuals 35, 36, and 37
- Activities 12 and 13

Note: You may wish to impersonate Adam Smith and conduct the press conference presented in this lesson as a whole-group activity. If you do, you will need a pair of buckle shoes, a long topcoat, a ruffled white shirt, a white wig, and a tricornered hat. Smith was known to his contemporaries for being absentminded. For example, he sometimes would become lost when going on walks near his home. Joking about your difficulty in finding the classroom and speaking in a Scottish brogue can add fun to this lesson.

PROCEDURE

A. Explain that the purpose of this lesson is to analyze how incentives can be used to encourage food production.

B. Display Visual 35. Invite students to speculate on why, when we have a scarcity of farm land and a growing world population, the people of Earth are nonetheless unlikely to face worldwide food shortages.

C. Explain that part of the solution to this mystery lies in understanding that technology can make workers more productive. Display Visual 36 and review the definition of *productivity*.

D. Demonstrate how technology can be used to increase productivity. Distribute Activity 12. Begin round one of the demonstration by ask-

ing the students to complete as many problems as they can in Column I in two minutes. After the two minutes are up, display Visual 37. Read the answers to the problems in Column I to the class. Ask a sample of students how many problems they completed correctly, calculate an average, and record the average on Visual 37. Students, for example, may have completed an average of six problems correctly. Next, divide the average wage of $1 by the number of problems ($1÷6 problems =.17). Record the average cost per correct problem on Visual 37 (.16).

E. Begin round two by asking students to complete as many problems as they can (in Column II of Activity 12) in two minutes. In this round, however, the students should be allowed to use a calculator. After two minutes, display Visual 37. Read the answers to the problems in Column II to the class. Ask a sample of students how many problems they completed correctly, calculate an average, and record the average on Visual 37. Students, for example, may have completed an average of nine problems correctly. Next, divide the average wage ($1) by the number of problems ($1÷9 problems =.11). Record the average cost per correct problem (.11).

F. Discuss the results of the demonstration. Students should note that adding technology by use of calculators made them more productive producers of correctly solved mathematics problems. The cost of producing each problem declined. Invite the students to speculate on other ways they could increase their productivity in solving problems.

G. Explain that the students' productivity increases gained through their use of calculators are similar to what has been occurring in food production around the world. New technologies have increased the productivity of farmers. As a result, food prices have declined as the amount of food produced has increased. Other explanations, however, are also related to the food-production mystery.

H. Distribute Activity 13. Explain that the students are going to conduct a press conference across time with Professor Adam Smith, the founder of the study of economics. Read aloud the **Scene** and **Reporter Background** in Activity 13 to prepare the class for working in small groups.

I. Divide the class into small groups of five. Assign each group member a role—as Adam Smith or as one of the four reporters. Groups with fewer than five members may wish to assign two reporter roles to one student. Have the students conduct the press conference with Adam Smith. When they are done, ask:

1. Who was Adam Smith?
(The first modern economist; he wrote the *Wealth of Nations* in 1776.)

2. Smith says, "It is not from the benevolence of the butcher, the brewer, or the baker that we can expect our dinner, but from their regard to their own interest." What does this mean? How does it relate to food production?
(Smith means that people produce things for others when it is in their own interest to do so. Farmers, for example, grow food for others because they are rewarded for doing so.)

3. Is all the agricultural land in the world being used today?
(No. Idle land can be brought into production in North America as well as in parts of Asia and Africa.)

4. How has technology improved productivity in agriculture?
(Beginning in the 1950s, the Green Revolution developed new types of wheat and rice, which dramatically increased food production. Today, genetically improved types of rice have doubled yields per acre. New varieties now under development will increase production by making plants more resistant to drought, flood, salt, and insects.

5. Will science save us from world hunger?
(No. Economic rewards will provide the answer. People will experiment with new technologies to produce food only when

they think there will be some economic benefit to them in the future.)

6. How can governments encourage food production?
(Governments can encourage food production by protecting the right of people to benefit from growing food on their land. When governments destroy this right, food production declines—as it did in Russia when Stalin ordered the collectivization of agriculture. Parts of Africa today face declining levels of food production for the same reason.)

7. How can expanding world trade help increase food production?
(Farm land is unevenly distributed around the world. People in different parts of the world must be able to depend on buying food on world markets at competitive prices.)

CLOSURE

Review the key points of the lesson. Ask:

1. What is Adam Smith's invisible hand?
(In response to rewards, people are willing to produce things that other people wish to buy. These rewards allow both sides in an exchange to be better off.)

2. How might the invisible hand reduce problems of food production?
(Farmers have been very responsive to rewards. New technologies have helped farmers to produce more food at lower prices.)

Pose this situation to the class. Imagine that teachers and family are trying to invent new ways to encourage students to learn more—to be more productive. Specifically, they want students to learn more in less time. They want students to do this voluntarily. What suggestions would you make?
(Students might suggest greater use of computers in the classroom, academic competitions with real prizes, and so on.)

ASSESSMENT

Multiple Choice

1. Productivity refers to the
   a. average level of prices over a period of time.
   *b. total output per worker during a period of time.
   c. average output per worker during a period of time.
   d. total level of prices over a period of time.

2. Adam Smith was the first modern
   a. astronaut
   b. environmentalist
   c. historian
   *d. economist

Essays

How do economic rewards affect food production? Explain your answer.
(Economic rewards encourage farmers to be productive. Farmers who want to be productive use new technologies. Technology developed in the Green Revolution has produced improved types of wheat and rice. Genetic research today is developing new types of rice that will resist drought, flood, salt, and insects.)

According to Adam Smith, how can government help feed the people of the world?
(Government can help by protecting the right of people to benefit from growing food on their land. Farmers should be able to keep any profits they earn. When governments have destroyed this right, food production has fallen.)

Journal

Go through the refrigerator and cupboards at your home. Read the labels to see where the various food items were produced (Brazilian coffee, Hawaiian sugar, and so on.) Make a list of all the nations that help to feed your family.

VISUAL 35
ECOMYSTERY: WILL THERE BE FOOD FOR YOU?

It is almost certain that Earth's population will increase to 10 billion by the year 2050. Many people are alarmed by this, thinking that food production cannot possibly keep up with population growth. But the dire predictions of Thomas Robert Malthus in 1798 have consistently been proven wrong. How can this be? When Earth's population grows, why don't people on Earth starve?

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VISUAL 36
PRODUCTIVITY

Productivity is the average output produced per worker during a specific time period. It is usually measured in terms of output per hour worked.

Technological advancements are an important source of higher productivity. For example, these inventions have increased productivity:

Steam engine

Internal combustion engine

Jet engine

Computers

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VISUAL 37
WHAT DOES A CORRECT ANSWER TO A PROBLEM COST?

ROUND	WAGE	AVERAGE NUMBER CORRECT	AVERAGE COST PER PROBLEM
1	$1.00		
2	$1.00		

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ACTIVITY 12
MATHEMATICS PROBLEMS

Name_____

Directions: You will be given two minutes per work period to complete the problems below. Try to answer correctly as many problems as possible in the time limit. Wait for your teacher's instructions before beginning.

Column I	Column II
1. 48 + 55 =	1. 23 + 38 =
2. 34 + 88 – 9 =	2. 55 + 19 – 4 =
3. 12 x 30 =	3. 14 x 50 =
4. 15 x 25 =	4. 17 x 25 =
5. 43 x 22 =	5. 33 x 12 =
6. 587 ÷ 12 =	6. 754 ÷ 12 =
7. 360 ÷ 50 =	7. 817 ÷ 30 =
8. 655 ÷ 50 =	8. 255 ÷ 20 =
9. (5 x 16) + (80 x 16) =	9. (3 x 13) + (60 x 15) =
10. (7 x 10) + (8 x 9) =	10. (9 x 4) + (4 x 11) =

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ACTIVITY 13
THE ADAM SMITH PRESS CONFERENCE

Name _____

Scene
The United States National Aeronautics and Space Administration (NASA) has developed a device called the Time Warp Traveler (TWT). The device allows scientists to bring people back from the past into the present. Today, reporters have been invited to interview Adam Smith, who lived from 1723–1790. The topic of today's press conference is the future of world food production.

Background for Reporters
Today you are interviewing Adam Smith. Smith was born in Kircaldy, Scotland, in 1723. He studied at the University of Glasgow and at Oxford. He spent 10 years writing *The Wealth of Nations*. Published in 1776, *The Wealth of Nations* was the first complete work on the role of government and the economy. Smith is widely regarded as the founder of modern economic thought. One of Smith's best known statements was about self-interested actions. For example, we know that people earning money from their own labor benefit themselves. Unknowingly, however, they also benefit others: to earn income from their own labor, they must produce something valued by others. Smith argued that such self-interested behavior is guided by "an invisible hand" that brings benefits for all parties in an exchange. The "invisible hand" idea also led Smith to stress the benefits of free world trade.

Reporter 1
Professor Smith, I am sure I speak for all of my colleagues today as I offer you a warm welcome to our 20th century. I am sure that our world holds many surprises for you.

Professor Smith
It is a great pleasure for me to be speaking with you and your colleagues. And, of course, I have been very surprised, even shocked, by some of the differences I see between life in your century and life in my own. Yet, as I have read the latest reports about population problems in your time period, I am pleased to tell you that people still act in ways that are very understandable to me.

Reporter 2
Professor Smith, today many people are worried that we will not have enough food to feed future populations. Yet, the price of food has been declining for the past 50 years. In fact, we are producing more food than ever before. Why?

Professor Smith
In my book, *The Wealth of Nations*, I said that "It is not from the benevolence of the butcher, the brewer, or the baker that we can expect our dinner, but from their regard to their own interest." It is clear to me that farmers in your century are rewarded for growing food. Food prices have declined because farmers are rewarded for finding new ways to produce food.

Reporter 3
Professor Smith, as the founder of modern economics, you know that we all face scarcity. Earth only has so much land and topsoil for us to use in growing food. As the population continues to grow, isn't worldwide starvation only a matter of time?

Professor Smith
You sound much like a young man of my century, Thomas Malthus, who teaches at Cambridge University, or was it Oxford? Oh, never mind .... I will tell you the same thing I told him. Planet Earth has an abundance of land for farming. Throughout history, new land has been brought into production. Your new continents of North and South America—mere colonies in my day—added much to our ability to produce food. Food also can be produced in parts of Europe, Asia, and Africa that have not previously been used for food production. Total food production has grown much faster than the population. In fact, government programs in Europe and the United States today pay farmers *not* to use productive land.

ACTIVITY 13 (continued)

Reporter 4
So, Professor Smith, do you think that just bringing idle land into production will solve our problem of feeding the world's growing population? We'll run out of new land some day, won't we?

Professor Smith
Bringing new land into production is not the solution. In fact, bringing idle land into production may be the least important factor. It is far more important to see that rewards are provided to farmers who find new ways to be more productive on existing land.

Reporter 1
What are some of those ways?

Professor Smith
Throughout history, people have invented new ways to be more productive in food production. People in Southeast Asia invented wet-rice culture systems. In the middle of your century, the Green Revolution scientists developed new types of wheat and rice, and their efforts dramatically increased food production. I just read a 1995 report from the International Rice Research Institute in the Philippines. It explains the development of genetically improved types of rice that have doubled yields per acre. New varieties now under development will increase production by making plants more resistant to drought, flood, salt, and insects.

Reporter 2
So, Professor Smith, are we to believe that science will provide the answer to all our problems?

Professor Smith
No. I believe that economic rewards will provide the answer—if we allow them to work. People will experiment with new technologies to produce food only when they think there will be some economic benefit to them in the future. This is a good example of my idea of the invisible hand at work.

Reporter 3
Okay, Professor Smith, I understand the importance you attach to rewards and the invisible hand. But this invisible hand business sounds a little mysterious. Isn't there a role for government—just to make sure that the invisible hand does its job?

Professor Smith
Of course. Governments play a vital role. Governments must protect the right of people to benefit from growing food on their land. In other words, farmers should be able to keep the profits they generate by producing food for others. When governments destroy this right, food production falls. This has happened often in your century. Food production declined in Russia when Joseph Stalin took farms from Russian peasants in the 1930s and had the government run the farms. Much the same thing has happened in parts of Africa today.

Reporter 4
Professor Smith, you are a supporter of expanding world trade. Would this also help food production?

Professor Smith
Expanding trade is very important. Farmland is unevenly distributed around the world. For people in Hong Kong to live happily, they must be able to depend on buying food in world markets, at competitive prices. Governments that encourage free and open trade will do much to help the world feed its growing populations.

Reporter 1
Professor Smith, I see that our time together is about to end. Thank you very much for granting this press conference.

Professor Smith
It has been a pleasure. Please invite me back to your century again. Perhaps you would like to visit me. Now, if I could just find that Time Warp contraption.... I know I put it somewhere....

Reporter 1
Thank you, Professor Smith.

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ACTIVITY 13 (continued)

Questions for Discussion

1. Who was Adam Smith?

2. Smith says, "It's not from the benevolence of the butcher, the brewer, or the baker that we can expect our dinner, but from their regard to their own interest." What does this mean? How does it relate to food production?

3. Is all the agricultural land in the world being used today?

4. How has technology improved productivity in agriculture?

5. Will science save us from world hunger?

6. How can governments encourage food production?

7. How can expanding world trade increase food production?

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LESSON FOURTEEN
DO WE MAKE TOO MUCH STUFF?

BACKGROUND

People concerned about the future frequently predict that the world will be much poorer tomorrow because we are using up so many resources today. For example, in 1972 The Club of Rome report on the *Limits to Growth* predicted that the world would run out of gold, mercury, tin, zinc, petroleum, copper, lead, and natural gas by 1993. None of these forecasts has come true, yet people continue to worry because such forecasts seem to make common sense. We cannot continue to use Earth's limited resources without eventually running out of resources. This lesson helps students analyze this problem in light of the idea that prices and substitutes influence our use of resources.

ECOMYSTERY

We make so much stuff! Every day we use up more petroleum, natural gas, gold, zinc, oxygen, and water. If we keep using all these resources, will there be anything left for our children?

ECONOMIC REASONING

Prices influence resource use. Higher prices encourage producers to find more resources or to develop substitutes. Higher prices also encourage users to conserve on their use of a declining resource. Because prices and substitutes have these effects, we will never run out of resources. For example, it literally would be too expensive to pull the last drop of oil from the earth. Rising prices would slow our consumption of oil and encourage the production and use of substitutes long before we got to the last drops of petroleum in the earth's crust. The same analysis also explains why we will not run out of other natural resources.

ECONOMIC CONCEPTS

Rewards
Prices
Substitutes

OBJECTIVES

1. Students explain how prices influence the availability of natural resources.

2. Students use the concepts of *substitutes* and *incentives* to evaluate predictions of resource depletion.

TIME

One class period

MATERIALS

◆ Visual 38

PROCEDURE

A. Explain that Americans are often criticized for being materialistic. The purpose of this lesson is to explore the idea that we may be making too much stuff. Explain that students are going to consider the future today. Ask: Do you think that in 20 years the people of the world will still have enough natural resources to make things for themselves and their children?
(Accept a variety of responses. Write samples of the students' opinions on the chalkboard.)

B. Display Visual 38. Explain that today's mystery has to do with resource depletion. Remind students that an important principle of ecodetection is that people's choices are influenced by rewards.

C. Explain to students that you are going to conduct an experiment with them, to help them solve this mystery.

D. Ask students to imagine that this is a physical education class, an *unusual* physical education class in which students are paid to produce repetitions of physical activity. It is important to the school that the teacher gets the students to produce repetitions of physical activity, and the school is willing to pay for these repetitions. The school will pay by giving students extra points on tests in their other classes—social studies, math, English, and so on.

E. Remind students that a finite resource is pre-

sent in the class. The class contains only a limited number of students, and they are physically capable of producing a set amount of activity.

F. Now it is time for the experiment. Push-ups may be used as the physical activity to be repeated. Ask:

1. How many push-ups can we get from the class if the school pays each student one point on his or her next test for each push-up?
(Put the number suggested on the chalkboard.)

2. How many push-ups can we get from the class if the school pays each student 10 points on the next test for each push-up?
(Put the number suggested on the chalkboard.)

3. How many push-ups can we get from the class if the school pays each student 25 points on the next test for each push-up?
(Put the number suggested on the chalkboard.)

G. Ask students to analyze the information produced by this experiment. The following questions may help:

1. What happens to the number of push-ups as the reward (points) increases?
(The number of push-ups should increase.)

2. Why has the number of push-ups increased?
(The reward to provide push-ups has increased, so people either do more push-ups or new people (resources) are brought into use.)

3. What could be done if you were tired—unable to do push-ups because your strength was depleted—but you still wanted to get the extra points?
(Maybe you could use your energy sparingly, by not doing a *full* push-up. Maybe you could go down and up a little bit. You are to be paid for the number of repetitions, not for how deep and complete the push-up is. But isn't that just a trick? Well, compare that question with a question about cars. We do not use as much steel in cars now as we did 30 years ago. People still want cars. But they don't buy them based on the steel content.)

4. What could be done if you were unable to produce push-ups of *any* kind—if you had completely depleted your arm strength?
(You could switch to some other form of activity, such as jumping jacks or pulling on a rowing machine. You can find a substitute activity for push-ups because the school is paying for physical activity repetitions, not push-ups.)

5. What do you think the school officials would do if you refused to do any more activity unless you were paid a million dollars each for every push-up?
(They would find other producers who would work for less, or they would find some other service they wanted to buy instead of repetitions of physical activity. Maybe they would settle for videotapes of people performing physical activity.)

6. How do rewards influence your behavior and the behavior of school officials?
(Increased rewards encourage people to find more resources, to use existing resources more efficiently, or to find substitutes for resources. Paying higher rewards encourages "buyers" of the physical activity—school officials—to want less of a resource, to seek alternative producers, or to seek an alternative resource to satisfy their desires.)

H. Explain that the prices charged for resources are the rewards that encourage or discourage the production and consumption of resources. At higher prices, resource producers are encouraged to produce more, but resource buyers will buy less. At lower prices, resource producers will produce less, but resource buyers will buy more.

I. Display Visual 38 again. Ask:

1. Will we run out of resources for our children? (No. Higher prices will encourage greater production, more efficient use, and the development of substitutes.)

2. Will the goods and services bought by our children be made from other resources than the resources we use today? (Very likely this will be true.)

CLOSURE

In 1972 The Club of Rome published a book called *The Limits to Growth*, which predicted that by 1993 the world would run out of petroleum and natural gas. Obviously, that hasn't happened. Explain how we know that this prediction was a bad one; use the concepts of *rewards*, *prices*, and *substitutes* in your explanation.
(If the world supplies of petroleum and natural gas were almost gone, we would see prices increasing for these products; producers would put less on the market; buyers would buy less, and it would take longer to reduce the supplies. Also, substitute energy forms would be widely used. None of these activities has occurred or is occurring.)

ASSESSMENT

Multiple Choice

1. Which of the following statements is true?
   a. Prices don't influence how much consumers buy.
   b. Prices don't influence how much producers make available.
   c. Higher prices are a positive incentive to buy more products.
   *d. Higher prices are a positive incentive to produce more products.

2. If you wanted to use less natural gas to heat your home, which of the following items might be a substitute for natural gas?
   a. Electricity.
   b. Warm clothing such as sweaters.
   c. Living with someone else at his or her home.
   *d. All of the above are substitutes for natural gas heating.

Essay

Read the following statement:

"The only way to slow down the rapid depletion of our natural resources is to stop buying things. We must all begin to live very simple lives and have no children."

Whether you agree with the writer or not, use the concept of *rewards* to suggest an alternative way to conserve resources.
(Prices are rewards that influence people's behavior. If you use prices to reward people for producing items that use very few new resources, or for recycling old resources, you could have less resource depletion.)

Journal

Find and note in your journal examples of substitute products being used in the world around you. For example, what are some new uses of recycled paper?

VISUAL 38
ECOMYSTERY: THE CASE OF THE DEPLETION OF RESOURCES

We make so much stuff! Every day we use up more petroleum, natural gas, gold, zinc, oxygen, and water. If we keep using all these resources, will there be anything left for our children?

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LESSON FIFTEEN
SAVE THE BABIES

BACKGROUND

Americans want to have a clean environment—clean air, pure water, and unspoiled land. Or do we? While cleaning up the environment is very important, so is education, health care, housing, food, transportation, and recreation. In this case study, the citizens of Pretty Prairie, Kansas (population: 600), are being required to spend $450,000 to clean up their water in order to protect babies in the community from a dangerous blood disease. They love their children, but they do not want to spend the $450,000.

ECOMYSTERY

Why might the people of Pretty Prairie refuse to spend $450,000 to improve the health of their babies?

ECONOMIC REASONING

The people of Pretty Prairie, Kansas, face the central economic problem of scarcity. Their resources (land, labor, capital, and entrepreneurship) are limited, while their wants are unlimited. There simply are not enough productive resources to satisfy all the wants of any of society's members. Therefore, people must choose, and every choice involves a cost. We cannot have it all.

Economic reasoning suggests that, in dealing with scarcity, people weigh the future costs and benefits of each possible alternative and select the one with the best combination of costs and benefits. This idea is easily stated, but it is sometimes difficult to implement because people vary in their thinking about costs and benefits. Some people love the majesty of a gigantic redwood tree, and others love to sit on their redwood deck enjoying the sunset.

It is also true that, in thinking about costs and benefits, government regulators are likely to differ from the people they are regulating. Why? First, regulators do not pay the costs; they impose costs on others. Second, the regulators' benefits are different. Politicians and government officials are as self-interested as business people and consumers. Business people attempt to earn profits, and consumers attempt to improve the quality of their lives. Politicians and government officials attempt to gain power, stay in office, and receive prestige as well as income. (This is the thesis of public choice theory.)

ECONOMIC CONCEPTS

Benefits
Costs
Public Choice Theory
Scarcity

OBJECTIVES

1. Students use cost-benefit analysis to decide how best to protect the health of the babies in Pretty Prairie, Kansas.

2. Students compare the costs and benefits of the federal government's solution of the problem to the costs and benefits of the solution proposed by the citizens of Pretty Prairie.

TIME

One class period

MATERIALS

- Visual 39
- Activity 14

PROCEDURE

A. Explain that today's lesson stresses how environmental choices involve costs and benefits and how government rules sometimes have unintended results. Display **The Principles of EcoDetection** and review each of the principles of ecodetection.

B. Stress that people must make environmental choices because of scarcity. These choices affect environmental quality.

C. Explain that people's environmental choices also involve costs. Ask students how they would decide whether to study or go to a movie. What is the cost of studying? (Not seeing a movie.)

What is the cost of going to a movie? (Not studying and getting lower grades.)

D. Ask the students if the environment should be cleaned up regardless of cost.
(Many students will probably say yes. However, the principles of ecodetection suggest that costs must be considered. While cleaning up the environment is very important, education, health care, housing, food, clothing, transportation, and recreation are also important. In a world of scarcity, we must use the most efficient method of achieving a goal.)

E. Explain that people weigh future costs and benefits as they make environmental decisions. A careful decision should consider both costs and benefits. Ask:

1. What are the costs of going to a movie?
(Students have already considered this; now try to develop several other costs including monetary costs.)

2. What are the benefits of going to a movie?
(Fun, entertainment, relaxation, socialization, and so on.)

3. What are the costs of studying?
(Less fun, less relaxation, less time for hobbies and friends, and so on.)

4. What are the benefits of studying?
(Higher grades, approval of family, a better chance of getting into college.)

5. How do students decide whether to study or go to a movie?
(Compare the costs to the benefits.)

F. Display Visual 39 and discuss the nature of the mystery. Tell students that understanding future costs and benefits is the key to solving the mystery.

G. Distribute Activity 14 and ask students to respond to the questions.

H. Discuss the answers:

1. Bottled water had a lower cost. If the babies could remain healthy at a lower cost, the residents could have the same benefits while sacrificing fewer other things. Money saved in this way could be spent to solve other problems.

2. The EPA did not have to pay the costs. Stress that the costs and benefits for EPA regulators were different.

3. It is difficult to defend the EPA's decisions on the basis of cost-benefit analysis.

CLOSURE

Display Visual 39. Ask students why Pretty Prairie would refuse to spend $450,000 to improve their babies' health.
(Because they could achieve the goal of good health by another means, at a lower cost.)

ASSESSMENT

Multiple Choice

1. People have to make choices because:
   a. Our wants are limited.
   b. Our resources are unlimited.
   *c. Our wants are greater than our limited resources.
   d. Most people are greedy.

2. What is the best way to make an environmental choice?
   a. Pick the option that cleans up the environment the most.
   b. Pick the option that costs the least.
   *c. Pick the option that has the best combination of benefits and costs.
   d. Pick the option that costs the government the least and keeps taxes low.

Essay

If you rely on the principles of ecodetection, would you agree or disagree with this statement? "Good health is so important that it must be preserved regardless of cost."
(Disagree. All decisions should be based on comparing costs and benefits. Money spent on health care cannot be spent on housing, food, education, or cleaning up the environment. People have to make choices about health because our resources are scarce and our wants are unlimited.)

Journal

Write down two decisions you had to make last

week about whom to be with on Saturday and what to do on Monday after school. What were the costs and benefits of each alternative? Why did you make the decision you made?

VISUAL 39
THE HEALTHY BABY MYSTERY

Why would the people of Pretty Prairie refuse to spend $450,000 to improve the health of their babies?

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

ACTIVITY 14
PROTECTING OUR BABIES

Name_____

The U.S. federal government says the town of Pretty Prairie, Kansas (population: 600), has an environmental problem. The water in Pretty Prairie has too many nitrates in it. The federal government's Environmental Protection Agency (EPA) wants to reduce those nitrates from 20 parts per million to 10 parts per million. This reduction would lower the risk of "blue-baby syndrome," a treatable blood condition that can affect babies under the age of six months.

The EPA ordered Pretty Prairie to build a new water treatment plant or dig a new well. Either solution would cost the town about $450,000. The residents objected. At the time the issue arose there were only four babies under six months old in the town, and all were healthy. The town's solution to the problem was to buy bottled water for the babies. The EPA said, "No way." The town's citizens continued to object. They decided to buy bottled water for all 600 residents. The EPA repeated, "No way." Pretty Prairie must spend $450,000 to dig a new well or build a new treatment plant.

Questions for Discussion

1. Why did the residents of Pretty Prairie want to buy bottled water instead of digging a new well or building a new treatment plant? (Hint: Consider costs and benefits.)

2. Why did the EPA not let them do this? (Hint: Consider costs and benefits.)

3. Do you agree with the residents of Pretty Prairie or with the EPA? Why?

Case study adapted from Ann Reilly Dowd, "Environmentalists Are on the Run," *Fortune*, Sept. 19, 1994, p. 91.

From *Economics and the Environment: EcoDetectives*, © National Council on Economic Education, New York, NY

LESSON SIXTEEN
WHY WOULD PEOPLE CUT DOWN TREES IN A PUBLIC PARK?

BACKGROUND

Local, state, and federal governments have important economic functions. Often governments provide parks, wilderness areas, and wildlife sanctuaries when citizens think such services will not be provided in the private sector. Yet, governments can also pursue environmentally unfriendly policies. Incentives must exist that are consistent with environmentally friendly behavior in order for government policies to successfully protect the environment. The case study in this lesson deals with a situation in Ravenna Park, Seattle, Washington, and provides an explanation of how one of the finest collections of giant red fir trees in the world was destroyed while under the management care of the Seattle Park Service.

ECOMYSTERY

Why would 400-foot fir trees disappear after the government bought the forest land for a public park?

ECONOMIC REASONING

Some people believe that government officials act selflessly to serve the interests of the people. According to this theory, it would not make sense for a government to buy a park and then destroy the trees in it.

However, the public choice theory of government helps us understand how government destruction of trees can make sense. In 1986, James Buchanan, a professor at George Mason University, received the Nobel Prize in economics for this theory of governmental decision making. Alan Meltzer, an economist at Carnegie-Mellon University, summarized Buchanan's theory as follows (*The Wall Street Journal*, Oct. 17, 1986):

He started a whole new field of political economy. Economic theory was concerned with the government's choices of policy. It didn't think about the mechanism that would cause a policy to be adopted. What Professor Buchanan did was to put the best parts of political science and economics together.

In the past most economists assumed a good-will theory of government. If political leaders had a choice to follow a policy that benefited the general public, they would follow that policy rather than a policy that benefited a few at the expense of many. In practice, that was a naive notion. Abundant evidence exists as examples of special interests (subsidies for farmers, tariffs to protect workers and businesses, special financing for exporting corporations, hiking trails for backpackers, research grants for professors, and so on) influencing government policy to provide them with special privileges at the expense of the general public.

Professor Buchanan developed a credible theory to explain this political phenomena. He assumed political decision makers make decisions the same way that other people do. They consider their own self-interest as well as the public's interest. These two considerations may not always be the same and political decision makers will make choices based on potential costs and benefits of those decisions.

According to public choice theory, politicians and government officials are as self-interested as business people. But instead of trying to maximize profits, "political entrepreneurs" seek to maximize other rewards—power, salaries, income, prestige, and votes. In the private market, competition channels self-interested behavior so that it does serve the public good. Adam Smith said an individual's self-interested behavior was "guided by an invisible hand to promote an end which was no part of his intention. Nor is [this] always the worse for society .... By pursuing his own interest he frequently promotes [the interest] of the society more effectually than when he really intends to promote it." Mr. Buchanan maintains that the *political* "invisible hand" is different; it is more likely to serve private ends than to benefit the public.

For example, the park when owned by private individuals was well cared for because the owners received income and pleasure from owning the

park. However, when the park became government property, the park service and its employees received no income from the existence of the trees. In addition, there was potential income from illegally selling the trees as firewood if the employees cut down the trees. If the employees thought the public didn't care if they cut down the trees there was little cost to the employees of cutting the trees and receiving income from the sale of firewood. Whatever the situation, it is clear that the incentives for some park service employees were very different from the incentives for the private owners. That change in incentives caused the trees to be treated very differently.

ECONOMIC CONCEPTS

Benefits
Costs
Incentives
Profits
Public-Choice Theory

OBJECTIVES

1. Students compare government management of land with management of land under private ownership.

2. Students explain why government policies sometimes fail to represent the interest of citizens.

3. Students analyze how private ownership provides incentives to protect resources.

TIME

One class period

MATERIALS

- Visuals 40 and 41
- Activity 15

PROCEDURE

A. Explain that the purpose of this lesson is to examine public and private ownership of parks. Display Visual 40. Ask students which of the two statements they tend to agree with. Encourage students to support their choice, but do not try to influence their answers.

B. Display Visual 41. Encourage students to speculate on possible explanations. Write their ideas on the chalkboard.

C. Distribute Activity 15 and invite the students to read it. This letter is fictitious, but it is based on a true story. For the real story, read "Grass is Always Greener in a Public Park" by Terry L. Anderson and Jane S. Shaw in *The Wall Street Journal*, May 28, 1985. Discuss the questions at the end of the reading. Ask:

1. Why did the Becks take such good care of Ravenna Park?
(The park was a business. The Becks received income by charging admission fees. If the park declined in beauty, fewer people would be willing to pay for touring the park.)

2. Why were people willing to pay an admission fee to visit Ravenna Park?
(The customers felt it was worth the price. The benefits of visiting the park were equal to or greater than the opportunity cost of visiting the park.)

3. Why did the giant fir trees start to disappear soon after the city purchased the park?
(Some park system employees cut them down illegally and sold the wood.)

4. Why did the city and some park system employees cut down the trees after the city purchased the park?
(Park officials chose to cut some trees because they thought the trees were a safety hazard. They were afraid the trees might blow over and fall down during a wind storm. The city could make short-term gains by cutting the trees and selling them. Some employees illegally cut other trees and sold them for firewood. It is not known if the people in charge encouraged this behavior. They did not find out about it and stop it even though "rustling" several large trees is a very obvious event that took several days to accomplish.)

5. How did incentives affect people's behavior in the Ravenna case?
(People are more likely to take better care of property they own and value.)

D. Display Visual 41 again, and ask students to solve the mystery. While the Becks had an incentive to preserve the trees, the park service did not. When the park service agency compared costs and benefits, they chose short-term gains from cutting the trees and selling the wood.

CLOSURE

Display **The Principles of EcoDetection** to review the mystery. The discussion would follow along these lines:

1. "People's choices influence the environment." The decision to have the Seattle Parks Department buy the park and supervise its use set up a set of incentives that lead to the destruction of the large trees in the park. Park safety, maintenance, and firewood revenue became more important than preserving large, old trees in Seattle.

2. "People's choices have unintended results." No one intended for the trees to be cut down.

3. "People's choices are influenced by rewards." The Becks were rewarded for saving the trees. They received admission fees, and the value of their property increased. The park service employees gained rewards by cutting the trees. By reducing the number of trees, they improved park safety and by cutting down additional trees illegally, they gained revenue from firewood sales.

4. "People are more likely to take better care of things they own and value." (The Becks took better care of the old trees in the park than did the Seattle Parks Department.)

ASSESSMENT

Multiple Choice

1. Why do private owners generally try to improve their property?
   a. The government requires them to do it.
   *b. The property is worth more if it is improved.
   c. Private owners have no costs when they improve their land because it belongs to them.
   d. It is usually an unintended consequence of government rules and regulations.

2. Which of the following statements is true?
   a. Democratically elected officials sometimes think of the public's interest before their own.
   b. Private owners never mismanage their property.
   *c. Private owners have incentives to improve their property.
   d. Unlike private owners, government leaders and employees rarely consider their self-interest.

Essay

A city is considering buying a private golf course in order to preserve the open land. Give one argument in favor of the government buying the golf course and one argument against the government buying the golf course.

Arguments for Government Purchase

A. Unless the government bought the golf course, the land might be used for private development. The open space would not be preserved if an alternative use were more profitable.

B. The government would allow everyone to use the open space, including those who could not afford to pay the private owners for using it. .

Arguments against Government Ownership

A. All citizens would have to pay for the public golf course (through taxes) even though some citizens would never use the public golf course.

B. The government has less incentive to keep the park in good condition, while private owners have a profit motive to keep up the property.

C. If the government buys the property, it will no longer collect taxes from the property owners.

D. If the government charges lower fees than the market price for the use of the golf course as a policy to allow many people to use it, there will be more people wanting to use the golf course than can play at any one time. Some rationing system will be set up to deal with the over crowding that will take place.

VISUAL 40
WHO WOULD TAKE BETTER CARE OF A PARK?

Which of these statements do you tend to agree with?

1. The government would take better care of a park. In a democracy, government leaders and employees represent the people. The people care about the environment. Therefore, the government would protect parkland and not let it be spoiled by private owners, who care only about profits. Besides, a public park would be free to all citizens.

2. A private owner would take better care of a park. A private owner could charge a fee for visiting the park. If the park did not look nice, people wouldn't pay to visit it. If the owners did not keep the park looking good, they would not make a profit on the park, and they might have a hard time eventually selling it. Therefore, they would keep the park looking nice.

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VISUAL 41

ECOMYSTERY: THE CASE OF THE MISSING GIANT FIR TREES

Why would 400-foot fir trees disappear after the government bought the forest land for a park?

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ACTIVITY 15
A LETTER FROM A TREE LOVER

Name_____

Read the following letter. It is based on a true story. Answer the questions at the end.

Dear Mr. and Mrs. Beck:

How are you getting along in your new home? I thought you would be interested in what has happened to your beautiful Ravenna Park. I loved going there. A recent story in the newspaper said that 8,000 to 10,000 people visited your park every day. But it still was always a beautiful, restful place to me. It was like a different world and seemed so far away from the city. Walking among the red fir trees was a wonderful experience. I loved to hike the trails through the ravine. I also liked it when you had concerts in the park. Of course, I bought the $5 yearly membership. What a good deal! Even though the daily admission was only 25 cents, I saved money using the yearly pass.

You wouldn't believe what has happened to Ravenna Park since you sold it to the city. When you sold it, I thought it was a good idea. Ravenna Park would be open to the public at no cost. This would be one area of Seattle that wouldn't be chopped up into little lots and become another housing development. There would always be this nature preserve inside our city. It would be like a gift to future generations.

Well, Ravenna is still a park, but you wouldn't recognize it. Soon after you sold it, the giant fir trees began disappearing. Your beautiful "Roosevelt" fir was one of the first to go. The park superintendent said it was "a threat to public safety." He admitted they had cut it down and sold it for firewood. We were mad, and he said it wouldn't happen again. He said, however, that the sale of firewood raised money to maintain the park.

The superintendent maintained the park in a strange way. Soon almost all the giant firs were gone. People complained so much and were so mad that we asked a forestry professor at the university to investigate. It turned out that some of the city park service employees were illegally cutting down the trees and selling the wood. They thought this was a good way to make extra income. I guess they didn't care. They didn't own the trees, so how did they benefit from saving them? After all, they couldn't charge an admission fee to the park.

They have charged some employees with theft. It would be nice if they would be convicted, but it still wouldn't be justice. It certainly won't bring the trees back.

I'm sorry to give you such bad news. I know the city ordered you to sell the park to them, and I know they have the power to do this. I sure wish, though, that you still owned the park. I miss those giant fir trees.

(Based on a report by Terry L. Anderson and Jane S. Shaw in *The Wall Street Journal*, Tuesday, May 28, 1985. Terry L. Anderson and Jane S. Shaw are associated with PERC [Political Economy Research Center] in Bozeman, MT.)

Questions for Discussion

1. Why did the Becks take such good care of Ravenna Park?

2. Why were people willing to pay an admission fee to visit Ravenna Park?

3. Why did the giant fir trees start to disappear soon after the city purchased the park?

4. Why did park system employees cut down the trees after the city purchased the park?

5. How did incentives affect people's behavior in the Ravenna Park case?

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LESSON SEVENTEEN
THE MYSTERY OF THE DISAPPEARING CHRISTMAS TREES

BACKGROUND
The environmental movement has placed much emphasis on the importance of recycling to save scarce resources. Recycling involves reusing various products such as paper, glass, and aluminum rather than placing them in landfills.

ECOMYSTERY
How might a new law requiring Americans to purchase artificial and reusable Christmas trees result in fewer trees in our countryside?

ECONOMIC REASONING
All choices involve costs as well as benefits. Tree farmers can make many choices regarding the use of their land. Banning the sale of traditional Christmas trees might make the cost of growing Christmas trees no longer worth the benefit. Tree farmers would use their land for other things.

ECONOMIC CONCEPTS
Costs
Benefits
Unintended Results

OBJECTIVE
Students identify the unintended results of environmental decisions regarding recycling and reuse.

TIME
One class period

MATERIALS
- Visuals 42 and 43
- Activity 16

PROCEDURE
A. Explain that the purpose of this lesson is to explore some costs and benefits of recycling.

B. Display **The Principles of EcoDetection**. Remind the class that environmental choices influence environmental quality and that our environmental choices involve costs. The choice to recycle waste—paper, aluminum, plastic—involves costs as well as benefits. Also, people's environmental choices have unintended results. Sometimes decisions made with good intentions can have the opposite effect.

C. Display Visual 42. Ask:

1. What is a Christmas tree?
   (If it's a natural tree, it is one of the firs—balsam, spruce, or pine, for example)

2. What happens to these trees at Christmas time?
   (They get cut down and sold to people who decorate them for use in their Christmas celebration.)

3. What do some environmentalists propose to do regarding Christmas trees?
   (Some favor stricter rules which would require that people purchase artificial trees.)

4. Why might happen to the number of trees if this law were passed?
   (Accept a variety of responses at this time.)

D. Distribute Activity 16. Discuss the directions. Explain to the class that, like real detectives, they sometimes may have to speculate on some of their answers. However, the teacher will come around to the groups to provide hints. Divide the class into small groups.

E. After the groups have completed the true and false questions, discuss their responses.

1. Many people like to purchase real Christmas trees. (True)

2. Christmas tree farmers produce millions of Christmas trees every year. (True)

3. Christmas tree farmers grow Christmas trees because our government requires them to do so.

(False. People grow Christmas trees voluntarily in order to earn income from the sale of the trees.)

4. Christmas trees are grown on farms owned by individuals, not the government. (True.)

5. Tree farmers are not required to grow trees. They have many choices about how to use their land.
(True. They could use their land to grow other species of trees or crops, or they could convert the land to be used for outdoor recreation, resorts, housing, or building a new shopping mall.)

F. Ask students to return to their groups and write a statement that explains how requiring people to purchase artificial Christmas trees will result in fewer trees being grown. Their response might resemble the following:
Tree farmers can make many choices regarding the use of their land. Banning the sale of Christmas trees would make the cost of growing Christmas trees no longer worth the benefit. Tree farmers would use their farmland for other things. Our nation would have fewer real Christmas trees if such a law was passed.

CLOSURE

Explain that environmental decisions can have unintended results. Display Visual 43 and invite students to speculate on how restricting newspaper use could result in fewer trees. Explain that trees are usually grown specifically for use in producing paper. Much of the timberland is owned by individuals, not by the government. If people are interested in purchasing fewer trees to produce paper, then the owners of the land used to produce these trees may use their land for other purposes. The possibility that a waterslide park might be built where trees once covered the land is an example of the unintended consequences that might follow from rules about newspapers. Restricting the use of newspapers might cause many such unintended consequences.

ASSESSMENT

Multiple Choice

1. Requiring that people buy artificial, recyclable Christmas trees would likely result in the production of
a. more Christmas trees.
*b. fewer Christmas trees.
c. about the same number of Christmas trees.
d. fewer Christmas trees followed by more.

Essay

Explain what the effects might be of a rule requiring recycling of newspapers.
(Recycling newspapers conserves space in landfills. However, it may also result in fewer trees being grown, because the owners of forestland may no longer grow trees if the trees can no longer be sold for use in paper production. The land owners may decide to use their land for other purposes such as housing, recreation, or other forms of agriculture.)

Journal

Interview the people who run your local recycling program. Ask them about times when they have decided to place newspapers in the landfill and times when they have not. Write a paragraph describing what you learned.

VISUAL 42
ECOMYSTERY: THE CASE OF THE CHRISTMAS TREE SHORTAGE

Everyone loves trees. Sometimes, however, our love for trees can cause problems.

Christmas is an important holiday for many Americans. Buying and decorating the family Christmas tree is a tradition for millions of families. Each winter, almost like magic, thousands of tree lots are set up in parking lots and vacant spots in cities all across the nation. On these lots are many species of freshly cut fir trees. And, just as magically, all these Christmas tree lots vanish by New Year's Day.

Each year, some environmentalists say that people should buy artificial Christmas trees rather than real trees. Artificial trees are constructed out of materials that can be recycled. They think that requiring people to buy artificial trees will save real trees.

Imagine that the federal government passed a new law that required that all Christmas trees sold in our country must be artificial, not real. Would our country have more or fewer trees?

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VISUAL 43
ECOMYSTERY: HOW CAN FEWER NEWSPAPERS MEAN FEWER TREES?

Proposal:
Every day Americans discard tons of newspapers, and every day thousands of trees are cut to produce new paper. What a waste, especially since Americans really don't need daily newspapers anyway! They can watch TV news! We need a new law restricting newspaper production to one issue per week. That rule would mean we'd use only 1/7 the number of trees we're using now for newsprint, and as a result we'd have many more trees in our forests.

Counter-argument:
This proposed rule requiring fewer newspapers would cause us to have fewer trees.

Question:
How could a well-intended environmental policy to conserve landfill space have such a consequence?

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ACTIVITY 16
THE MYSTERY OF THE DISAPPEARING CHRISTMAS TREES

Name _____

Directions: Read the **Principles of EcoDetection** and the mystery. Read the clues to help solve the mystery. Discuss whether the clues are true (T) or false (F). Use one or more of the ideas from the **Principles of EcoDetection** to write a solution to the mystery.

The Principles of EcoDetection

1. People's *choices* influence the environment.
2. People's environmental choices have *unintended* results.
3. People's choices are influenced by *rewards*.
4. People are more likely to take better care of things they *own and value*.

Mystery

Imagine that the federal government passed a new law that required that all Christmas trees sold in our country must be artificial, not real. Would our country have more or fewer trees? Why?

True or False Clues

Read each statement below and mark it true (T) or false (F).

1. Many people like to purchase real Christmas trees. _____
2. Christmas tree farmers produce thousands of Christmas trees every year._____
3. Christmas tree farmers grow Christmas trees because our government requires them to do so._____
4. Christmas trees are grown on farms owned by individuals, not the government._____
5. Tree farmers are not required to grow trees. They have many choices about how to use their land._____

Write a few sentences to solve the mystery, using the one or more of the principles of ecodetection.

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LESSON EIGHTEEN
WHAT IS WORTH RECYCLING?

BACKGROUND

Americans love to recycle. Cities across the nation have set up curbside recycling programs, and millions of Americans sort aluminum cans, newspapers, cardboard, and plastics into separate containers. Many businesses also engage in extensive recycling.

ECOMYSTERY

Despite all these efforts, however, many bottles, cans, and papers still get tossed into landfills. Why do our recycling efforts fall short?

ECONOMIC REASONING

Americans do recycle. Individuals and private companies recycle voluntarily when there are sufficient incentives for doing so. If cans, bottles, and papers are still getting tossed into landfills, something must be wrong with the incentives.

ECONOMIC CONCEPTS

Incentives
Voluntary Exchange

OBJECTIVES

1. Students analyze recycling by reference to personal benefits and personal costs.

2. Students explain how incentives influence people in their decisions to recycle.

TIME

One class period

MATERIALS

- Visual 44
- Activities 17 and 18

PROCEDURE

A. Explain that the purpose of this lesson is to explore the incentives for recycling.

B. Display Visual 44. Invite the students to speculate on why some recyclable materials are not always recycled.

C. Explain that this mystery can be solved by application of the principles of ecodetection. Display **The Principles of EcoDetection** and briefly review the points. Stress the idea that voluntary choices can improve recycling efforts.

D. Distribute Activity 17. Ask the students to take the Recycling Quiz. Discuss their initial responses.

E. Distribute Activity 18. Discuss the answers provided to the quiz and compare them to the students' initial responses.

F. Display Visual 44 and **The Principles of EcoDetection** again. Ask the students now to solve the mystery. They might note that people's choices in regard to recycling do influence environmental quality. Recycling, however, does involve costs. People will voluntarily choose to recycle when the costs are low. When the costs are high, it may be better to place material in landfills and use the savings for other worthwhile purposes.

CLOSURE

Review the main points of the lesson. Ask:

Do people recycle voluntarily?
(Yes. Many companies make profits or reduce their costs by recycling paper, glass, aluminum, tires, and oil.)

Under what circumstances would you expect to see more voluntary recycling?
(When prices are high for recycled materials or when new technology enables recycling companies to make profits even when prices are low, then voluntary recycling will increase.)

Under what circumstances might people choose not to recycle?
(If the cost of recycling is too high, people will decide to place some materials in landfills and use the savings for other purposes.)

ASSESSMENT

Multiple Choice

1. Many companies recycle glass, aluminum, tires, and oil primarily because they wish to
   *a. earn a profit.
   b. fight city hall.
   c. claim a tax reduction.
   d. reduce competition.

Essay

How does recycling affect our supply of natural resources? Write an essay to answer this question. Explore different possible effects of recycling, and explain your thinking by discussing costs and benefits.
(Whether recycling saves resources depends on the costs and the benefits involved. If the means used to recycle a product are very expensive—consuming many resources—it might be better not to recycle and place the material in a landfill.)

Journal

Call a recycling company. Ask about the price for recycled cardboard and whether the company is accepting cardboard. With this information in mind, write a story in which you imagine that you are a discarded cardboard box. Consider three alternative futures. Explain what you think will actually happen to you.

VISUAL 44
ECOMYSTERY: WHY ARE THERE BOTTLES AND CANS IN LANDFILLS?

American love to recycle. Millions of Americans sort aluminum cans, newspaper, cardboard, and plastics into separate containers. But many bottles, cans, and papers are still tossed into landfills. Why?

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ACTIVITY 17
RECYCLING QUIZ

Name _____

True or False: Mark each statement below true (T) or false (F), according to the discussion in your group. Then discuss your responses with the class.

1. Some businesses voluntarily buy material that can be recycled. _____

2. Recycling happens only because government requires it. _____

3. Nearly anything can be recycled. _____

4. The United States is about to run out of landfill space. _____

5. Recycling always saves resources. _____

6. Recyclable materials are usually placed in landfills because of people's ignorance about what is good for the environment. _____

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ACTIVITY 18
ANSWERS TO THE RECYCLING QUIZ

Name _____

1. Some businesses voluntarily buy material that can be recycled.
   True. Some well-established businesses specialize in recycling paper, aluminum, steel, and glass.

2. Recycling happens only because government requires it.
   False. The vast majority of recycling occurs voluntarily. Businesses have been involved in recycling for several years because recycling is profitable. Even before curbside recycling, people often recycled newspapers through newspaper drives. More and more aluminum cans are recycled because it is often cheaper to use recycled aluminum than to produce new aluminum.

3. Nearly anything can be recycled.
   True. The increased price of some recyclable materials has encouraged the development of new technologies for recycling. Nearly all materials may be recycled using super-hot furnaces that break waste down into molecules and atoms. The more important question is: how much does it cost to recycle particular materials?

4. The United States is about to run out of landfill space.
   False. Old landfills and dumps were unhealthy and dangerous to the environment. They threatened to harm ground water and attracted rats and other carriers of disease. When new government rules required that these landfills and dumps be closed, there was a shortage of landfill space. Today, public and private studies show that American cities have several years of landfill space and that much space exists for the construction of new landfills.

5. Recycling always saves resources.
   False. Whether recycling saves resources depends on the cost of recycling and the technology involved. Plastic containers, for example, require less energy to produce for one-time use than do containers made from glass or aluminum. If plastic containers are reused, they save even more energy.

6. Recyclable materials are usually placed in landfills because of people's ignorance about what is good for the environment.
   False. Often recyclable materials are placed in landfills because the costs of other alternatives are too high. In the early 1990s, mounds of newspapers and plastic were tossed into landfills because the price of these materials was very low. Recyclers had to be paid to take the material. By 1994, prices for cardboard and some plastics had increased substantially.

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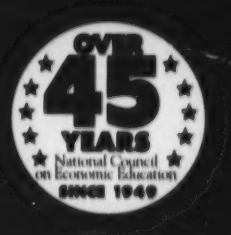

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